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The **Journal of the American Chemical Society** appears monthly, except during July and August. It will contain all papers read before the Society, as well as abstracts from American and Foreign Journals, and a list of American Patents relating to Chemical Industries.

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The Meeting Room and Library of the Society are in University Building, Washington Square, New York.

The Regular Monthly Meeting is held on the first Friday of every month, at 8 P. M.

Corresponding Secretary:

A. C. HALE, 551 Putnam Ave., Brooklyn, N. Y.

Treasurer:

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The Committee on Papers and Publications respectfully call attention to the resolutions of the Society, requiring that papers be submitted to the Committee before being read.

Authors will be furnished, gratis, with 20 reprints of each article published in the Journal, if application for the same be made when the article is sent.

Members are requested to give notice of any change of address, or failure in the delivery of the Journal. All communications relating to the Journal should be addressed to the Editor.

A. A. BRENEMAN, 97 Water St., New York.

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THE PHILADELPHIA MEETING.

The Second General Meeting of the American Chemical Society was held at Philadelphia in the Physical Lecture Room of the University of Pennsylvania, on December 30th and 31st.

The following chemists were registered at the meeting :

George F. Barker, Philadelphia, Pa.
C. C. Caldwell, Ithaca, N. Y.
H. Carrington Bolton, University Club, New York.
F. W. Clarke, Washington, D. C.
Albert C. Hale, Brooklyn, N. Y.
William L. Dudley, Nashville, Tenn.
Edward P. Harris, Amherst, Mass.
L. H. Friedburg, College of the City of New York.
J. A. Mandel, College of the City of New York.
William Rupp, School of Mines, New York.
E. H. v. Schweinitz, Washington, D. C.
C. E. Munsell, New York.
R. C. Schiedt, Lancaster, Pa.
A. H. Sabin, Long Island City, N. Y.
A. A. Breneman, New York.
Lee K. Frankel, University of Pa.
Samuel P. Sadtler, University of Pa.
Edward Hart, Easton, Pa.
Edward H. Keiser, Bryn Mawr, Pa.
L. G. Eakins, Washington, D. C.
H. B. Nason, Troy, N. Y.
John M. Maisch, Philadelphia.
George B. Miller, Philadelphia.
William Frear, State College, Pa.
Frank H. Rosengarten, Philadelphia.
Charles M. Cresson, Philadelphia.
H. H. Nicholson, University of Nebraska.
Charles B. Dudley, Altoona, Pa.
Edward Gudeman, Philadelphia.
L. E. Munoz del Monte, Chestnut Hill, Pa.
Elwyn Waller, New York.

Walter M. Saunders, Hughesdale, R. I.
John Howard Appleton, Providence, R. I.
Reuben Haines, Philadelphia.
Henry Pemberton, Jr., Philadelphia.
Morris Loeb, Worcester, Mass.
T. R. Wolf, Delaware College, Newark, Del.
Joseph F. Geisler, New York.
Herbert E. Smith, New Haven, Conn.
R. Ogden Doremus, New York.
Marcus Benjamin, New York.
Walter H. Kent, Brooklyn, N. Y.
Hugh Hamilton, Harrisburg, Pa.
Albert R. Leeds, Hoboken, N. J.
Charles A. Doremus, New York.
R. R. Fisher, Philadelphia.
Amos P. Brown, Philadelphia.
D. K. Tuttle, Philadelphia.
Albert P. Brown, Camden, N. J.
Thomas B. Stillman, Steven's Institute, Hoboken, N. J.
S. T. Skidmore, Philadelphia.
A. B. Prescott, Ann Arbor, Mich.
Charles A. Catlin, Providence, R. I.
A. C. Peale, Washington, D. C.
Pedro S. Salom, Philadelphia.
Henry Bower, Philadelphia.
W. R. Livermore, Corps of Engr's, U. S. Army.
Durand Woodman, New York.
J. H. Wainwright, U. S. Laboratory, New York.
John Marshall, University of Pa.
William H. Green, Philadelphia.
Walter J. Keith, Philadelphia.
Charles T. Pomeroy, Newark, N. J.
R. H. Bradbury, University of Pa.
A. W. McCanley, University of Pa.
Bruno Terne, Philadelphia.
Nath. Hathaway, New Bedford, Mass.
J. B. F. Herreshoff, Brooklyn, N. Y.
William Jay Schiefelin, New York.
Edgar Richards, Washington, D. C.
Theodore G. Wormley, Philadelphia, Pa
Marcus J. Oakes, New York.
C. E. Munroe, Newport, R. I.
A. P. Sharp, Baltimore, Md.
B. G. Morley, Chester, Pa.

The Committees for the Meeting were as follows:

Committee of Arrangements.

A. A. BRENEMAN, Chairman.

WM. RUPP,	C. F. CHANDLER,
A. H. SABIN,	WM. MCMURTRIE.

Local Committee.

GEORGE F. BARKER, Chairman,

HENRY BOWER,	GEORGE A. KOENIG,
CHAS. A. BRINLEY,	JOHN M. MAISCH,
ROBERT A. FISHER,	FRANK H. ROSENGARTEN,
FRED'K A. GENTH,	SAMUEL P. SADTLER,
WM. H. GREENE,	PEDRO D. SALOM,
EDW. GUDEMANN,	WALDRON SHAPLEIGH,
J. W. HOLLAND,	EDGAR F. SMITH,
SAMUEL C. HOOKER,	DAVID K. TUTTLE,
THOMAS S. HARRISON,	WM. H. WAHL,
EDW. H. KEISER,	THEODORE C. WORMLEY.

Committees of Conference appointed in response to the invitation of the American Chemical Society, in accordance with a resolution of the Newport meeting to consider the question of general organization of chemists in America:

By the American Chemical Society:

ELWYN WALLER, New York, *Chairman.*
*C. F. CHANDLER, New York.
J. H. APPLETON, Providence, R. I.
A. C. HALE, Brooklyn, N. Y.
A. A. BRENEMAN, New York.

By the Chemical Section of the American Association for the Advancement of Science:

F. W. CLARKE, Washington, *Chairman.*
H. CARRINGTON BOLTON, Washington.
W. L. DUDLEY, Nashville.
*W. H. ELLIS, Toronto.
*EDWARD HART, Easton.
MORRIS LOEB, Worcester
*E. W. MORLEY, Cleveland.
C. E. MUNROE, Newport.

A. B. PRESCOTT, Ann Arbor.
*R. B. WARDER, Washington.
*T. H. NORTON, Cincinnati.

By the Association of Official Agricultural Chemists:
*H. W. WILEY, Washington, *Chairman.*
*W. C. STUBBS, New Orleans.
G. C. CALDWELL, Ithaca.
WILLIAM FREAR, State College, Pa.
H. H. NICHOLSON, Lincoln, Neb.

By the Washington Chemical Society:
*W. H. SEAMAN, Patent Office, Washington, *Chairman.*
EDGAR RICHARDS, Int. Rev. Bureau, "
*T. M. CHATARD, Geol. Survey, "

By the Chemical Section of the Franklin Institute:
W. H. WAHL, Philadelphia.
W. H. GREENE.
S. C. HOOKER.

By the Chemical Section of the Brooklyn Institute:
W. H. KENT, Brooklyn, N. Y.

By the Manufacturing Chemists' Association of the United States:
HENRY BOWER, Philadelphia.

The preparations of the Local Committee for the reception and entertainment of the visiting chemists were admirably made and the programme of the meeting was carried out in every detail. The first business session was mainly given to reading of papers, most of which appear in the following pages.

Luncheon was served each day at the close of the session, in another building of the University close to the place of meeting.

On Tuesday afternoon an excursion was made to Gloucester, N. J., to inspect the works of the Welsbach Incandescent Gas Light Company. The process of making the gas lamps was shown in all its stages. The various tints of incandescence produced by varying the composition of the mixture of rare earths that form the mantle or network which becomes incandescent in a gas flame, were beautifully shown.

*Not present.

The most interesting part of the exhibition, however, to chemists was the large collection of compounds of the rare earths, especially those of neodymium and praseodymium.

There were shown :

150 kilos. of Lanthanum ammonium nitrate,
100 " " Neodymium " "
10 " " Praseodymium " "
10 " " Yttrium oxalate from fergusonite,
10 " " " " " gadinolite,
50 " " Zirconium nitrate.

In addition there were many specimens of oxides, carbonates, sulphates, nitrates, acetates and chlorides of neodymium and praseodymium, many salts of cerium, yttrium, lanthanum, thorium, ebrium, etc., and large quantities of monazite, cerite, samarskite, allenite, zircon, etc.

The prodigality in which these compounds were shown and the beauty of the preparations gave the exhibition a peculiar interest and significance for chemists.

The conference of representatives from different chemical organizations met on Tuesday morning and organized with Prof. A. B. Prescott as chairman, and Dr. H. Carrington Bolton, as secretary. The business of the meeting was referred, after some discussion, to a sub-committee, made up of the chairmen of the different committees, and the resolutions reported by this sub-committee were adopted by the conference with some modifications and are given in the Proceedings herewith.

On the evening of December 30th, a reception was given to the visiting chemists, by the chemists of Philadelphia, at the Manufacturers' Club.

The meeting of December 31st was given to the Inaugural Address of President Barker, to hearing the report of the Conference, and to the reading of papers.

In the afternoon visits were made to the U. S. Mint, the Franklin Institute, the Pennsylvania Museum, the Baldwin Locomotive Works, Berger & Engel's Brewery and the Central Station of the Edison Electric Lighting Co.

PROCEEDINGS OF THE SECOND GENERAL MEETING OF THE AMERICAN CHEMICAL SOCIETY.

Held at the University of Pennsylvania.

Philadelphia, Pa., December 30 and 31, 1890.

FIRST DAY, DEC. 30TH.

The meeting was called to order at 10:40 A. M. by Prof. H. B. Nason, President.

Prof. Edward Gudeman was appointed Secretary *pro tem.*

Dr. Wm. Pepper, the Provost of the University, was prevented by illness from making his intended address of welcome.

Prof. G. F. Barker read Dr. Pepper's letter of regret and, in the name of the University, welcomed the Society to Philadelphia.

Dr. Greene, Secretary of the Local Committee, read the following list of places to which invitations had been received by the Society:

Welsbach Incandescent Gas Light Co.
The U. S. Mint.
The Franklin Institute.
The Rhodes Mfg. Co.
The Baldwin Locomotive Works.
The Pennsylvania Museum.
The Bergner & Engel Brewing Co.
The Central Station of the Edison Electric Light Co.

The following names were then proposed as members:

Prof. H. Carrington Bolton, University Club, New York.
Prof. L. P. Kinnicutt, Worcester Polyt. Inst., Worcester, Mass.
Mr. J. T. Evans.
Prof. E. F. Ladd, Agri. Coll., Fargo, N. Dakota.
Mr. F. E. Dodge, N. Y. Tartar Co,, Brooklyn, N. Y.
Mr. Wm. D. Crumbie.

Mr. Edward Scherer, U. S. Laboratory, 402 Washington, St., New York.

As associates :

Prof. P. W. Bedford, College of Pharmacy, N. Y.

Prof. Chester Huntington, P. O. Box 1780, N. Y.

Mr. D. H. Burrell, Little Falls, N. Y.

Mr. A. P. Sharp, Baltimore, Md.

The reading of papers being in order the following were read:

*I. Note on Certain Reactions for Tyrotoxicon. H. A. Weber.

II. The Relative Merits of the Wanklyn and the Adams' Method in the Estimation of Fat in Milk Analyses. J. F. Geisler.

III. Exhibition of Alchemical Medals. H. C. Bolton.

IV. Method of Determining Indigo for Commercial Purposes. F. A. Owen.

† V. On a New Gas Burner. L. H. Friedburg.

VI. A Porcelain Gooch Crucible. G. C. Caldwell.

VII. Some New Laboratory Fixtures. G. C. Caldwell.

The meeting was adjourned at 1 P. M.

EDWARD GUDEMAN,
Recording Secretary *pro tem.*

SECOND DAY, DEC. 31ST.

The meeting was called to order at 11:15 A. M. by the Chairman, Prof. G. F. Barker, President of the Society for 1891, who delivered an Inaugural Address upon "The Borderland Between Chemistry and Physics."

The Secretary of the Local Committee then made some announcements in reference to the afternoon visits.

Prof. A. A. Breneman, Chairman of the Committee of Arrangements, then moved a vote of thanks to the parties named below.

To members of the Local Committee for their unwearying services and their many hospitalities.

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*I. and II. were published in December No. of this journal, Vol. XII., 10, *485* and *488*.

† V., VI. and VII. will be published in February No.

To Provost Pepper and the Dean and the authorities of the University for the use of the University Building for the meetings of the Society.

To the Board of Managers of the Franklin Institute.

To Col. Barrows and Dr. Waldron Shapleigh, of The Welsbach Incandescent Light Co.

To the Jefferson Medical College.

To Col. Bosbyschell and Dr. Tuttle of the U. S. Mint.

To the Baldwin Locomotive Works.

To the Bergner & Engel Brewing Co.

To Prof. W. D. Marks and associates at the Edison Central Station.

The motion was carried unanimously.

Dr. H. Carrington Bolton, as Secretary of the Conference, was then introduced and reported that there were at the Conference delegates present from seven different bodies, eighteen delegates in all and representing:

The American Chemical Society.

The American Association for the advancement of Science, Chemical Section.

Chemical Section, Franklin Institute.

Chemical Section, Brooklyn Institute.

The Association of Official Agricultural Chemists.

The Manufacturing Chemists' Association of the United States.

The Chemical Society of Washington, D. C.

Prof. Albert B. Prescott in the Chair, Dr. H. Carrington Bolton, Secretary.

The work of the conference had resulted in the formulation of the following

RESOLUTIONS.

Resolution 1. It is desirable that an American Association of Chemists be formed to embrace all existing American Chemical Organizations.

Resolution 2. Resolved, that this Conference recommend to all existing American Chemical Organizations that they call a meeting of their bodies to be held in Washington in connection with the meeting of the American Association for the Advancement of

Science for 1891 and that each of these organizations be requested to appoint a committee, or to continue their present committee for the further discussion of the subject submitted to the Conference now in session.

Resolution 3. Resolved, that this general Conference Committee, composed of the present sub-committees, or such others as may be appointed by the several organizations, be called together at as early a time as practicable before the joint meeting recommended in Resolution No. 2.

Resolution 4. Resolved, that meanwhile each sub-committee, through its chairman, by correspondence or otherwise, shall formulate such modifications of the Constitution of the American Chemical Society as it shall deem necessary to adapt it to the requirements of the Association proposed.

Resolution 5. Resolved that the chairmen of these sub-committees shall then, so far as possible, harmonize the views embodied in these reports of their several organizations and shall have printed for presentation at the joint meeting a report, or majority and minority reports, on a Constitution for the proposed Association of American Chemists.

Voted that the Chairman of this Conference, with Professor Clarke and Professor Hale, be a committee of three to select time and place for the meeting called for in Resolution No. 3.

Voted to request the American Chemical Society to print the minutes of this conference with their report of the proceedings of the Philadelphia meeting and to mail copies as widely as possible to chemists in North America.

The secretary of this Conference is desired to communicate the above resolutions to scientific journals with a view to obtain a wide publication of the same.

Adjourned to meet at call of the Chair.

H. CARRINGTON BOLTON,
Secretary of the Conference.

Voted that the Chairman of this conference with Prof. Clarke and Prof. Hale be a committee of three to select time and place for the meeting called for in resolution.

It was voted to request the American Chemical Society to print the minutes of this conference in the proceedings of the Philadelphia meeting, and to distribute among the chemists of the country as widely as possible.

The Secretary of the conference was directed to communicate the above resolutions to scientific journals with a view to obtain as wide a publication as possible.

Prof. A. C. Hale moved that the above request to print and circulate proceedings of the conference be adopted. Carried.

Prof. F. W. Clarke advocated a meeting in Washington at the time of the next meeting of the American Association for the Advancement of Science, when a number of other scientific societies would also hold meetings.

Prof. Barker then requested Prof. Prescott to take the chair and the following papers were read:

VIII. Chemical and Physical Changes Attendant upon the Sterilization of Milk. A. R. Leeds.

IX. On the Necessity for the Systematic Inspection of Wells in Cities and Towns. Durand Woodman.

X. Experiments in Milk Analysis. Elwyn Waller.

XI. The Chemical Products of some Disease Germs and Their Physiological Effects. E. A. V. Schweinetz.

XII. National and State Chemists in Criminal Trials. Clark Bell.

Prof. Prescott congratulated the society on the fullness of the meetings, the number and excellence of the papers, and on the promotion of fellowship among chemists.

The meeting was then adjourned.

DURAND WOODMAN,
Recording Secretary.

THE BORDERLAND BETWEEN PHYSICS AND CHEMISTRY.

By George F. Barker.

An Address delivered on assuming the Chair as President of the Society for 1891.

In thanking the American Chemical Society for the honor it has done me in electing me as its President for the year 1891, it seems fitting that I should use the present opportunity for the purpose of outlining very briefly one or two of the more important relations existing between chemistry and physics, which are now shaping the direction of investigation. The conception of the periodic law, first by Newlands, and subsequently by Lothar Meyer and Mendeléeff, will ever be regarded as marking an important epoch in the progress not only of pure chemistry, but also of the physics of chemistry as well. For not only does this law assert that the purely chemical properties of the elements are periodic functions of the masses of their atoms, but it asserts also that their physical properties are like functions. In consequence, the impetus which these assertions have given to investigation seems but little short of marvellous. Not only were new researches undertaken by the chemist to fix more precisely these atomic masses, new calculations made upon data already accumulated, and new relations experimentally established going to show the position of the doubtful elements in the periodic series; but the most elaborate experiments were begun also by the physicist upon the phenomena of solution, of density, of specific heat, of refraction, of electric conductivity and the like, in order to connect these physical properties with the mass of the atom; and thus to establish the predominant influence of the atom, even in molecular

physics. Maxwell long before had pointed out the advantages to be secured by what he happily called "the cross fertilization of the sciences." And Lord Rayleigh in his presidential address at Montreal, in following out this suggestion, had instanced "the neglected borderland between two branches of knowledge" as that "which often best repays cultivation." "I cannot help thinking," he says, alluding to the progress already made by general chemistry, "that the next great advance, of which we have already some foreshadowing, will come on this side." "If I might without presumption" he adds "venture a word of recommendation, it would be in favor of a more minute study of the simpler chemical phenomena."

At the outset however, it seems to me that a word should be said concerning the terminology of these closely allied sciences. If it be true that in both physics and chemistry, taken separately, precision of thought and consequent precision of language are dependent upon a precise use of terms, how much more true is it in that limiting region which lies between them. The terms here employed are borrowed in the main either from chemistry on the one side or from physics on the other. So that the chemist is quite as much bound to use the terms of physics in the physical sense as the physicist is to use those of chemistry in the chemical sense. As an illustration of this let us take the terms atom and molecule for example. To the chemist they represent perfectly definite portions of matter, the latter in general larger than the former, since the molecule is itself made up of atoms. So that in chemistry the molecule is commonly defined as the smallest particle of any substance which can exhibit the properties distinctive of that particular kind of matter; while the atom is considered to be the smallest particle of simple matter which can enter into the formation of a molecule. To the physicist, however, this distinction is not so obvious. In a lecture, delivered in 1883 before the Royal Institution of Great Britain upon the size of atoms, Sir William Thomson said: "I speak somewhat vaguely and I do not do so inadvertently, when I speak of atoms and molecules. I must ask the chemists to forgive me if I even abuse the words and apply a misnomer occasionally. The chemists do not know

what is to be the atom; for instance, whether hydrogen gas is to consist of two pieces of matter in union constituting one molecule and these molecules flying about; or whether single molecules each indivisible, or at all events undivided in chemical action, constitute the structure." The evidence upon which this criticism is founded is unfortunately too common. Vagueness in the use of these terms even among chemists is far too frequent. Bloxam, for example, defines molecules as "the smallest physical particles of matter;", and an atom he says is "the smallest imaginable particle of matter." The subsequent use of the terms atom and molecule as synonymous, in Sir William Thomson's lecture, however, shows that his atom is the atom of the physicist and corresponds to the molecule of the chemist. It is greatly to be desired that some agreement should be reached in the definition of these words. The simplest solution of the problem would be, of course, the abandonment of the word atom by the physicist, except when he makes use of it in the purely chemical sense.

In recent years, perhaps no terms in physics have been more sharply and more properly differentiated, than the terms "mass" and "weight." The former is a quantity of matter and its standard unit of measure is the gramme. The latter is a quantity of force and its unit is the dyne. Hence, strictly speaking, it is as unscientific to speak of a weight of ten grammes, or of a mass of ten dynes, as it is commonly regarded to refer to the length of a rod as having the value of twenty seconds, or to a time as being six yards long. Unfortunately, however, custom has so long sanctioned the use of the former expressions that we have ceased to regard them as inadmissible. Moreover, the law of gravitation tells us that the force of this attraction measured in dynes is directly proportional to the product of the attracting masses, measured in grammes. Whence by ellipsis, we speak of a weight of ten grammes as meaning the attractive force which the earth exerts upon a mass of ten grammes; *i. e.*, 9800 dynes. And of a mass of ten dynes as the mass upon which the earth's attraction would be ten dynes of force; *i. e.*, nearly one centigramme. In consequence units of mass have come into use as gravitation units of force.

This confusion of terms is most unfortunate. Mass is invariable

for any given body, no matter in what part of the universe it is and no matter to what conditions it may be subjected. It is an invariable attribute of matter itself. Weight, on the other hand, depends upon the presence and attraction of other bodies in the vicinity of the body in question, and is therefore an entirely accidental attribute of matter. Indeed, a body may have no weight, even in presence of other matter, provided that the sum of the attractions in opposite directions be zero ; as is the case, for example, at the centre of the earth. It is not surprising therefore that in physics it has been found essential to scientific precision, to use the word "mass" whenever quantity of matter is meant, and the word "weight" whenever the force of the earth's attraction is referred to.

Moreover, the distinction now drawn is practically recognized in ordinary life. Because of its convenience, weighing is the process by which mass is ordinarily measured. Coal is bought by the ton, beef by the pound and quinine by the ounce. In all these cases the purchaser desires the particular quantity of these substances indicated by these standards of mass respectively. Not only is the weight concerned, *i. e.*, the earth's attraction, entirely immaterial, but it is often undesirable. In other words, the less the weight, provided the mass be the same, the better. In rare cases it is true that weight as such, is the thing purchased ; as lead for the keel of a vessel or stone for ballast. In the same sense that mass, though proportional to weight is not weight, the standards used in weighing, while proportional to the earth's attraction, are not standards of weight but standards of mass ; *i. e.*, are not weights but are masses.

This confusion, so far from being lessened, is rather increased by the fact that the word "weight" is used in two senses. Not only is it employed to signify force, which is its legitimate definition, but it is also used as a synonym for "mass"; so that in many cases it is quite impossible to determine the particular sense intended. A definition, it has been well said, should clearly distinguish the thing defined from everything else. What place then can a term have in exact science, which, like the word "weight" connotes two entirely distinct ideas? For this reason it is that

the use of the word "weight" in the sense of mass has well nigh disappeared from the terminology of pure physics. The quantity of matter in a body is now always called its mass and is expressed in units of mass or grammes. The earth's attraction upon this quantity of matter is called its weight and is expressed in units of weight or dynes. Standards used in determining mass by weighing are properly termed standard masses and not standard weights. Moreover, the same is true of the terms derived from these fundamental ones. Density is the mass contained in unit volume and the density of a substance is the number of grammes of mass which occupies a cubic centimetre. The idea of specific gravity is retained in the term "relative mass," which is defined as the ratio of the mass of a body to the mass of an equal volume of water. In the same way, one body is said to be more massive than another when its mass is absolutely greater; and denser, when its mass is relatively greater; instead of using the term "heavier" in both cases. In short, physics has decreed, in order to secure the precision essential to scientific progress, that an absolute divorce should be granted between the terms "mass" and "weight," each being used only in its proper sense.

Chemistry, however, has hardly yet begun to recognize the importance of this decree; and in consequence serious confusion of ideas continues to result. In the 7th edition of an English chemistry of considerable repute, just issued from the press, I find for example the following definition: "Matter, in a chemical sense, is anything which possesses weight." Evidently the word "weight" cannot here be used in its legitimate sense of gravitative force; because at the centre of the earth matter exists, although it has no weight. It must therefore be employed in the sense of mass; and the sentence may be read "matter is anything which possesses mass": *i. e.*, quantity of matter. Thus read it becomes a truism and not a definition. It is this use of the word "weight" as a synonym for "mass," and which is clearly illegitimate, which is so common in chemical literature and which is so unfortunate. Thus I find in the Chemistry just referred to, the statement that "the unit of weight now very generally adopted by scientific chemists is one gramme of hydrogen, which measures 11·16 litres at 0° C. and

760 m.m. Bar;" a statement most perplexing to the average student, in comparison with the declaration "the unit of mass is a gramme," which is all that the quotation really states.

If all this be granted, and I think it must be, then another and a more radical change should be made in chemical terminology. I allude to a change in the expressions "molecular weight" and "atomic weight." Using the word "weight" absolutely and in its legitimate sense, these terms, as they are commonly used, have no meaning whatever. Neither the absolute attraction of the earth for a molecule nor its attraction for an atom, expressed in dynes, can have any constant value, since the earth's attraction is not the same at different points of its surface. How much more absurd then is it to speak of the absolute weight of an atom, say of hydrogen, as being the same upon the sun or upon a fixed star. If, however, the claim be made that the word "weight" is here used, not in an absolute but in a relative sense, then it appears to me that the whole question is conceded; since it is granted that the attribute implied in the term used must of necessity be an invariable attribute, independent of time and place, and this, in its essence, the word "weight" is not. It is true, of course, that relative atomic and molecular weights are invariable; but this is evidently only because the absolute weight of the standard of comparison varies from place to place, and in the same direction. Precisely as the apparent weight of a mass of lead would be constant everywhere if balanced against a standard kilogramme.

But this use of the word "weight" is not the use generally implied in the terms atomic and molecular weight. It is used in chemistry almost without exception as a synonym of the word mass. The very conception of an atom or of a molecule is that of a definite mass of matter. Atoms, says Lothar Meyer, are "individual isolated particles of matter, possessing definite and unvarying weights;" *i. e.*, masses. Even vortex atoms "are small but finite systems of matter which rotate about an endless curve as axis, and which, according to the investigations of Helmholtz, possess the peculiar property that their mass cannot be affected by external influences." Muir tells us that "the symbol of an element, *e. g.*, H, O, Cl, or of a compound, *e. g.*, H_2O, HCl, repre-

sents a definite mass of that element or compound"; and he defines "the maximum atomic weight of an element" as "the smallest mass, in terms of hydrogen as unity, of that element in a molecule of any compound thereof." "To every element" he says, "a number may be given which expresses the smallest mass of that element which combines with unit mass of some element chosen as a standard. These numbers also express the smallest masses of the various elements which severally combine with each other." So Remsen, in stating the law of multiple proportions, says: "If two elements, A and B, form several compounds with each other and we consider any fixed mass of A, then the different masses of B which combine with the fixed mass of A, bear a simple ratio to one another." In illustrating this law he states: "The mass of oxygen combined with a given mass of carbon in carbon dioxide is exactly twice as great as the mass of oxygen combined with the same mass of carbon in carbon monoxide." Again, the law which underlies all chemical action is known as the law of the conservation of mass. It asserts that "the mass of matter which takes part in any change, whether physical or chemical, remains unaltered." And, finally, we have the important law of the action of mass, which is thus given by Remsen: "Chemical action is proportional to the active mass of each substance taking part in the change."

Moreover, the terms "atomic mass" and "molecular mass" refer equally to invariable quantities of matter, whether the word mass be taken in the absolute or in the relative sense. The absolute mass of an atom of sodium is the same, at least if we may judge from the period of its vibration, upon the sun, Sirius and Aldebaran, as upon the earth. And invariability of absolute mass necessarily involves invariability relatively. At present, the atomic masses of the elements given in our text books, are all relative, being expressed in terms of that of hydrogen, taken as unity. But it is evident that from these relative masses, the absolute atomic masses of all the elements can be obtained by simple multiplication, so soon as we know the absolute mass of the hydrogen atom. According to Lothar Meyer, "under a pressure of one atmosphere and at the mean temperature of about

20°, one cubic millimetre of any gaseous substance which obeys Avogadro's law contains about 21 trillions of molecules. But as one cubic centimetre of hydrogen under the given conditions weighs (*i. e.*, has the mass of) 0.0835 milligramme, the weight (mass) of a molecule of hydrogen must be $\mathfrak{H}=H_2=\frac{0.0835}{21.10^{18}}=\frac{4}{10^{21}}$=0.000,000,000,000,000,000,004 milligrammes; or a quadrillion molecules of hydrogen weigh (have a mass of) about four (milli) grammes."* Hence if we may assume that such a molecule as this is the molecule of Avogadro's law and consists of two atoms the conclusion is easy that a quadrillion hydrogen atoms have an absolute mass of two milligrammes. Whence the absolute mass of a quadrillion chlorine atoms is 70.74 milligrammes, of a quadrillion oxygen atoms 31.92 milligrammes, of a quadrillion nitrogen atoms 28.02 milligrammes, etc. In other words, the number expressing the relative molecular mass of an element, represents in milligrammes the absolute mass of a quadrillion atoms of that element.

These considerations make sufficiently evident, I think, the great gain that would accrue to chemistry in clearness of conception and precision of expression, were the word "mass" always to be employed whenever quantity of matter is referred to and the word "weight" only when the force of the earth's attraction is meant. True it is indeed, that the adoption of this rule will oblige us to give up the older and more familiar terms "atomic weight" and "molecular weight," and to substitute in their places the newer ones "atomic mass" and "molecular mass." But true progress in any science is attended with frequent revisions of its terminology; and in none more than in chemistry. It is a sufficient reason for such a change to show that thereby the science becomes better equipped for the further conquest of truth.

Returning now from this digression, it seems to me that one of the most noteworthy steps of progress recently taken is to be found in the analogy pointed out by Van't Hoff, between

* Modern Theories of Chemistry, p. 111.

gases and dilute solutions. In pure physics, the kinetic theory of gases as developed by Clausius, Maxwell, Boltzmann and others has led to the most important generalizations and has established the constitution of gaseous masses upon a firm foundation. From the simple assumption that the molecules of matter in the gaseous state are moving in straight lines, and that they are subject in consequence only to the laws of mass motion, conclusions have been derived which agree so closely with the facts as to make it appear that the properties exhibited by substances when in the gaseous state are necessary results of this fundamental hypothesis. Permit me briefly to recapitulate some of these conclusions. It follows in the first place that the pressure exerted by a gas outwardly is due simply to the impact of its molecules; so that if m be the mass of a molecule and v its speed $\frac{1}{2}mv^2$ will represent its kinetic energy and $\Sigma\frac{1}{2}mv^2$ the kinetic energy of the mass of unit volume; a value which becomes $n.\frac{1}{2}mv^2$, if n like molecules having a mean speed v are contained in unit volume. For a second gas, the kinetic energy of unit volume will be $n'.\frac{1}{2}m'v'^2$, of course. But since the outward pressure exerted by the gas is due to its kinetic energy, this energy must be the same for equal volumes of any two gases when they are under the same pressure; *i.e.*, that of the atmosphere. Whence we have

$$n.mv^2 = n'.m'v'^2$$

If now these two gases have the same temperature, they are in thermal equilibrium and $mv^2 = m'v'^2$; whence $n = n'$ and the number of molecules in unit volume is the same for both gases; which is the law of Avogadro. Moreover, since $mv^2 = m'v'^2$, we have $v^2 : v'^2 :: m' : m$; or the speed of translatory motion in a gas is inversely proportional to the square root of its molecular mass; *i. e.*, of its density; which is Graham's law of diffusion. Again, since the molecules are moving in all directions we may resolve this motion along three perpendicular axes; so that the actual pressure in any one direction is $p = \frac{1}{3}mnv^2$. Now although we may not know the actual value of either m or n, yet we do know their product mn, which is the mass of the molecules in unit volume; *i. e.*, the density of the gas. Representing this by δ, we have $p = \frac{1}{3}\delta v^2$. Hence the density of a gas varies directly as

the pressure upon it; which is the law of Boyle or Marriotte. Since $V=1/\delta$, or the volume of a gas is inversely as its density, the law may be stated in its ordinary form—the volume of a gas varies inversely as the pressure upon it. So, since $\delta = mn$, $\delta' = m'n'$, and $n = n'$, we have $m : m' :: \delta : \delta'$; or the molecular masses of two gases are directly proportional to their densities, which is the law of Gay Lussac. If the temperature is constant, the mean speed is constant, and pV, which equals $\frac{1}{3}v^2$, is also constant. As pV is proportional to the absolute temperature, v must be so. Hence the volumes of all gases are proportional to the absolute temperatures, and therefore expand and contract equally by heat; which is the law of Charles. From the equation $v^2 = 3p/\delta$ we may calculate this mean speed of translation. Thus for hydrogen at 0°, Clausius obtained $v = \sqrt{\frac{3 \times 1033 \times 980}{.0000896}}$ or 1844 metres per second. For oxygen it is 461 and for nitrogen 492 metres. The fruitfulness of the kinetic theory, it will be noticed, is not confined to physics, even in the case of gases, since it is upon the law of Avogadro, a direct conclusion from it, that the ordinary method of fixing molecular masses by means of vapor-density depends.

A like richness of results seems likely to follow the application of the kinetic theory to solutions. Van't Hoff supposes "a solution contained in a vessel of semi-permeable material, that is to say material permeable only by water molecules but not by the molecules of the dissolved substance, and that this vessel is immersed in water. Then owing to the attraction of the molecules of the dissolved substance, water will enter the vessel, thus causing an increase of pressure, and this will continue until the pressure within the vessel is sufficient to counterbalance the attraction exercised by the molecules of the dissolved substance. Equilibrium being thus established the pressure within the vessel is equal to the osmotic pressure and may be taken as a measure of it." Evidently by providing the vessel with a piston the pressure may be varied so that water may be made to flow out of the vessel or into it, at will. Hence in this way it becomes possible to produce a reversible cycle

of changes like that of Carnot, to which the second law of thermodynamics may be applied. Thus by decreasing the pressure water enters, and then by increasing it again water issues; so that the liquid may be brought back to its original state, the sum of the positive and negative work done upon and by it being zero. Now Van't Hoff has experimentally shown that in isotonic solutions, *i. e.*, solutions for which the osmotic pressure is the same, the pressure is directly proportional to the concentration. But as the concentration is proportional to the density, this is evidently equivalent to the statement that the osmotic pressure of a solution is directly proportional to its density; which is Boyle's law applied to liquids. Moreover, "if we consider the entrance of the water and subsequent increase of pressure to be proportional to the number of molecules which come into contact with the walls of the cell in a given space of time, the argument is similar to that by which Boyle's law is looked upon as due to molecular bombardment" in the case of gases. The same result has been obtained by Duhem by applying the law of the thermodynamic potential to osmotic relations, as a purely theoretical deduction. Again, it has been experimentally shown that the theoretical conclusion deduced by the aid of one of the reversible changes just mentioned, to the effect that the osmotic pressure is proportional to the absolute temperature, is true for a variety of solutions. But this is the law of Gay Lussac applied to such solutions. A third theoretical deduction from the reversible cycle principle is that a gas when in solution, has an osmotic pressure equal to the pressure of the same gas when in a free state. But this is simply an extension of the law of Avogadro to solutions; so that we may say "that for equal osmotic pressures and equal temperatures, equal volumes of different solutions contain the same number of molecules;" this number being the same as that which is contained in the same volume of a gas under the same conditions of pressure and temperature. In fact, Van't Hoff has shown that the osmotic pressures of a one per cent. sugar solution at different temperatures agrees with the pressure exerted by hydrogen gas containing the same number of molecules at the same temperature. Further, Duhem has obtained an expression, as a deduction from thermo-

dynamic theory, by means of which when the vapor-pressure of a solution is known, the law of compressibility of water vapor being also known, it becomes possible to calculate the vapor pressure of an isotonic solution. So that assuming the laws of Boyle and Gay Lussac to be applicable to water vapor, it follows that two isotonic solutions at the same temperature have approximately equal vapor pressures. Moreover, Duhem finds that theory proves the law of Van't Hoff that two isotonic solutions have the same solidifying point at the pressure for which they are isotonic, to be rigorously true. From the simple conclusion, deducible as a corollary from these laws, that solutions in the same solvent which have equal maximum vapor pressures or equal freezing points, must be isotonic, the well known law of Raoult, connecting the molecular reduction of the freezing point and the vapor-pressure with the molecular mass, may be readily obtained ; provided always that Avogadro's law holds for solutions. The great value of this law of Raoult in fixing the molecular mass, especially of organic non-volatile solids, has been very generally recognized. It may be enunciated thus : A molecule of any compound substance when dissolved in 100 molecules of any liquid upon which it has no action reduces the freezing point of this liquid by a quantity which is nearly constant and which closely approximates to 0.62. As an example of the method of applying the law, the following experiment may here be cited. A solution of dextrose containing 8.3704 grammes in 94.86 grammes of water was observed to freeze at $-0.94°$C. Hence its molecular mass is

$$M = T\frac{P}{C} = T\frac{100x}{CF} = 19\frac{100\times 8.3704}{0.94\times 94.86} = 179$$

In this equation M is the molecular mass, T the molecular depression, C the observed depression, x the grammes of the substance and F the grammes of water in 100 grammes of the solution. Since this value is practically the same as 180, the value calculated from $C_6H_{12}O_6$, it follows that the formula ordinarily given for dextrose represents correctly its molecular mass. The results obtained by this method for colloids are extraordinary. Thus Sabanéeff finds for the molecular mass of colloidal tungstic acid values from 679

to 995, for molybdic acid 608–631, for glycogen 1545–1625, for silicic acid 800 to 1600, and for egg-albumin 15,000.

A second subject of recent interest lying in the borderland between physics and chemistry, to which I would ask your attention is that of electrolysis, a phenomenon now regarded as a true electrical convection of atoms; "a procession of positively charged atoms travelling one way and a corresponding procession of negatively charged atoms the other way," as Lodge tells us. The charges thus carried are all precisely the same for atoms of the same valence; and they have therefore a minimum value for monads, twice this value for dyads, three times this for triads, etc. This minimum value is the smallest quantity of electricity that is known to take part in any physical or chemical change and has been called therefore a natural unit of electricity. If we may assume the data given by the kinetic theory, this monad charge may be calculated. Since according to Lodge, to decompose one gramme of water 1.5×10^{13} electrostatic positive units must be expended in charging the two hydrogen atoms in each molecule; and since in one gramme of water there are 10^{25} molecules, the charge upon the hydrogen of each molecule will be 1.5×10^{-12} electrostatic unit; or nearly 10^{-12} electrostatic unit on each hydrogen atom. This is about the 400 trillionth of a coulomb. Since the potential of a charged sphere is the ratio of its charge to its radius, the potential of the electrified hydrogen atom would be $10^{-12}/10^{-10}$ or 10^{-2} electrostatic unit; about 3 volts. The attraction between two atoms, say of hydrogen and chlorine thus charged, being proportional to Q^2/d^2 is $10^{-24}/10^{-20}$ or 10^{-4}; about one ten thousandth of a dyne only. Owing to its small mass however, even this force is sufficient to impress upon it an acceleration nearly a trillion times greater than that produced by the attraction of gravity. Helmholtz in his Faraday lecture, has calculated the attraction exerted by these atomic charges, and finds that the charges on the atoms in one milligramme of water, if these could be separated and distributed upon two spheres a kilometre distant from each other, would produce a force of attraction equal to the weight of 26800 kilogrammes. This electric force, he calculates, is 71000 billion times greater than the gravitative attraction of the hydrogen and oxygen atoms. "Although

therefore" he says "the attracting forces exerted by the poles of a little battery able to decompose water, on such electric charges as we can produce with our electric machines, are very moderate, the forces exerted by the same little apparatus on the enormous charges of the atoms in one milligram of water may very well compete with the mightiest chemical affinity." "I think" he concludes "the facts leave no doubt that the very mightiest among the chemical forces are of electric origin."

One of the most noteworthy of the phenomena of electrolysis is the fact that the ions set free by the action of the current appear only at the electrodes; and this, although there is a continuous procession of these electrically charged ions traveling in each direction. The hypothesis of Grotthuss, that a series of decompositions and recompositions occurs along the line of molecules between the electrodes, although suggestive, is defective in that the molecules are assumed to be at rest; and moreover, it requires the expenditure of some energy within the electrolyte itself; "and no hypothesis which involves a tearing asunder of molecules in the interior of a homogeneous electrolyte can be permitted." As early as 1851, Williamson, in his classic paper on etherification, had suggested the idea that in the collisions between molecules, atomic exchanges were continually effected. In 1857, Clausius applied this hypothesis to electrolysis. In his view "the separation of the ions is due to the active movements of the particles, molecules as well as atoms, which tend to bring about the dissociation of the compound, so that only bodies capable of dissociation can act as electrolytes. For the purpose of electrolysis it is not necessary that this dissociation should proceed as far as the complete separation and isolation of the constituents, but it is sufficient that there should be a frequent exchange of their constituents when two particles collide, so that each constituent can for a very short time move apart from the others before it again finds an opportunity of uniting with another isolated particle. This sporadic occurrence of isolated molecular fractions is not perceptible to our senses, so long as they are uniformly distributed throughout the whole mass of the electrolyte, but it is only perceptible when some external action collects large quantities of one class of particles at

one place and of the others at another." This view of continual decomposition and re-formation of molecules has a certain analogy with the theory of exchanges in heat. It "forms the basis of the kinetic theory of chemical changes now universally adopted." "In order to explain electrolysis it is necessary to assume that as each molecule decomposes, one portion of it carries off a definite fixed amount of positive electricity and the other an equivalent quantity of negative electricity. The electricity is either attached to each particle before the separation or else it is produced at the moment of decomposition. Clausius regards the movement of the charged ions in opposite directions as due to the free electricity present upon the electrodes. Here the ions receive from the electrodes an equal quantity of the opposite electricity, and so become neutral. Evidently the vast majority of molecules in an electrolyte are quite insusceptible to the influence of the electrodes. It is only the small number of these molecules which are dissociated by collision or otherwise and whose atoms are set free each with its appropriate charge that respond to the directive tendency of the electrodes. Hence the electrolytic conductivity of a solution depends not only upon the mobility of the molecules within it but also upon the number of such molecules dissociated. Researches by Wiedemann and others upon the relation exisiting between the internal friction or viscosity of liquids and their electrolytic conductivity have shown the close connection between this conductivity and the mobility of the molecules, and have proved resistance to conductivity to be a constant of the same order as resistance to friction. Morever, Long has observed that liquid conductivity and diffusion run parallel under similar external conditions; that a substance which diffuses rapidly, is, as a rule, a good conductor. This close connection between speed of diffusion and conducting power is evidence in favor of the view that it is only the movement of the ions and not their separation which is the work of the electricity. When a weak solution is made stronger, the increase of conductivity is due to increased dissociation. When a cold solution is made hotter, the increase is probably due to the diminished viscosity of the liquid.

This movement of the ions, the anion toward the anode and the

kation toward the kathode, has been called by Hittorf the migration of the ions; and he has shown that the speed of travel of the ions is not the same for them all. Thus for example, if a dilute solution of copper sulphate be electrolysed with copper electrodes, the solution at the kathode becomes weaker while that at the anode becomes stronger. Evidently the explanation of this result is to be found in the fact that the anion SO_4 travels faster than the kation Cu. This subject has been further investigated by Kohlrausch, who adopts the view that electrolytic conduction is performed by dissociated atoms, each of which carries the same numerical charge of electricity, one set of these atoms being positive, the other negative. The speed of the ionic motion, he agrees with Quincke in believing to be proportional to the slope of potential through the liquid. But he maintains that every ion has a specific speed of its own in a given liquid and when urged by a given slope of potential; this speed being wholly independent of all other conditions. In proof of this position he has shown how to calculate this specific ionic velocity in absolute measure, from data founded on conductivity, concentration and migration. Hydrogen travels faster than any other kind of atom. And therefore since the conductivity of a liquid depends on the sum of the speeds of the two opposite atoms of the dissolved substance, acids are in general better conductors than their salts. The rates at which the following atoms can make their way through nearly pure water, when urged by a slope of potential of one volt per linear centimetre, are given by Kohlrausch as follows, in centimetres per hour: Hydrogen 1.08, potassium 0.205, sodium 0.126, lithium 0.094, silver 0.166, chlorine 0.213, iodine 0.216, and NO_3 0.174.

It would be interesting, did time permit, to consider the more recent progress made by spectrum analysis in its relation to chemical questions. The investigations of Auer, of Krüss and Nilson, of Boisbaudran and of Crookes have gone far to unsettle completely our previous conception of elementary matter. In place of atoms having identical masses, the new theory offers us a collection of variable masses, grouped about a definite mean position, representing the atomic mass. By the ordinary operations of chemistry groups only can be distinguished; these operations being far too

coarse to discriminate between the variable masses of a group. But the application of more refined processes, especially when long continued and made cumulative, readily effects this differentiation, and resolves matter hitherto considered elementary into sub-groups of substances to which Crookes has given provisionally, the name "meta-elements." The oscillations of the mighty electric pendulum which he supposes distributed the primordial matter on alternate sides of a median line as the all-pervading "protyle" or "urstoff" periodically condensed into atomic groups under the influence of the slowly decreasing temperature, is a conception of the genesis of the elements worthy in every way of its distinguished author. "Swinging to and fro to points equidistant from a neutral centre; the divergence from neutrality conferring atomicity (valence) of one, two, three and four degrees as the distance from the centre is one, two, three or four divisions; the approach to or retreat from the neutral line deciding the electronegative or electropositive character of the element, all on the retreating half of the swing being positive and all on the approaching half negative," the oscillations gradually decreasing in amplitude and the masses of the atomic groups continually increasing as the temperature falls, "this oscillating force must be intimately connected with the imponderable matter, essence or source of energy we call electricity." "The pendulum begins its swing from the electropositive side; lithium next to hydrogen in simplicity of atomic weight is now formed; then glucinum, boron and carbon. Definite quantities of electricity are bestowed on each element at the moment of birth, on these quantities its atomicity (valence) depends and the types of monatomic, diatomic, triatomic and tetratomic elements are fixed. The electronegative part of the swing now commences; nitrogen appears, and notice how curiously position governs the mean dominant atomicity. Nitrogen occupies the position below boron, a triatomic element, therefore nitrogen is triatomic. But nitrogen also follows carbon a tetratomic body and occupies the fifth position counting from the place of origin. How beautifully these opposing tendencies are harmonized by the endowment of nitrogen with at least a double atomicity and making its atom capable of acting as tri- and

pentatomic. With oxygen (di- and hexatomic) and fluorine (mon- and heptatomic) the same law holds and one-half an oscillation of the pendulum is completed. Again, passing the neutral line the the electropositive elements sodium (monatomic) magnesium (diatomic), aluminum (triatomic) and silicon (tetratomic) are successively formed and the first complete oscillation of the pendulum is finished by the birth of the electronegative elements phosphorus, sulphur and chlorine; these three, like the corresponding elements formed on the opposite homeward swing, having each at least a double atomicity depending on position." The significance of this hypothesis, however, lies in the experimental data obtained by Crookes himself, upon which it is based. By fractional precipitation with ammonia, repeated many thousand times, he established the fact that the element called yttrium consists certainly of five and probably of eight constituents; these constituents being characterized by special spectrum bands. A similar research on didymium led Krüss and Nilson to conclude that this element may be split into nine distinct components. Other elements, examined likewise by fractional methods, give signs of breaking down and affording "meta-elements." But here the importance of the spectrum method appears. It is solely by the character of the spectrum, obtained either by emission, by phosphorescence, or by absorption, that these constituents can be satisfactorily distinguished. And the pertinent question at once arises, is the presence of a single spectrum line of definite wave-frequency, characteristic of a meta-element? Or, in other words, has the meta-elemental atom only a single rate of vibration, so that in a group of such atoms, constituting what we now term an element, we may reason to the elemental complexity from the number of such meta-elemental spectrum lines?

Such facts as these it is which the chemist of to-day is called upon to correlate with his older knowledge. Do they not indicate most clearly a tendency toward a true statics and dynamics of atoms; toward a condition of exact science which will confer upon chemistry the power of prediction? The future of such a chemistry will be glorious. It will become the grandest of the sciences and its phenomena will task the highest powers of intellectual ac-

tivity. It is to the advancement of such a science, fellow members of the American Chemical Society, that we are privileged to devote our energies. May we each contribute something to hasten its progress.

EXHIBITION OF ALCHEMICAL MEDALS.

By Dr. H. Carrington Bolton.

The speaker exhibited perfect facsimiles of three medals struck to commemorate alleged transmutations.

No. 1 bears no date, but as it bears the name of Francis II., Duke of Saxony, it can be assigned to the period between 1581 and 1619. The original purports to be of silver; on the obverse are many inscriptions arranged within and without a central triangle, accompanied by emblematic devices. The reverse is of a similar character, and has symbols of antimony and calx. The medal is mentioned by Reyher and other numismatists.

No. 2 has the appearance of a piece of soft white metal hammered into shape by an unskilled hand. The obverse has a representation of Saturn as Chronos, and the reverse bears the following inscription (Translation): "In the month of July, 1675, I, Doctor J. J. Becher, transmuted by hermetic art this ounce of purest silver from lead." This inscription associates this unique medal with the eminent German chemist, Johann Joachim Becher, who, with Stahl, founded the Phlogistic Theory. His biography is well known.

No. 3 is of suppositious gold and adorned with figures and letters in high relief. The obverse has a large figure of Saturn, and the symbol for lead, with the words "A golden offspring begotten of its parent lead." The reverse bears no ornaments but has a long Latin inscription setting forth that this piece was struck at the Castle of Ambros in the Tyrol, in commemoration of a transmutation effected December 31st, 1716, by His Highness, Charles Philip, Count Palatine of the Rhine.

The originals of these medals were found by Dr. Bolton in the Imperial Cabinet of Coins, Vienna; the Director of the Cabinet

Anno 1675 mense Julio
Ego J. J. Becher Doctor
Hanc uncinam argenti finissimi
ex plumbo arte alchimica
transmutavi

PLUMBO PROGNATA PARENTE LUNA
PROGENIES

PAX HOMINIBVS BONAE VOLVNTATIS
GLORIA IN EXCELSIS DEO ET IN TERRA

DEO
PROPITIO
SEGVRVS
AGO

METAMORPHOSIS
CHYMICA
SATVRNI IN SOLEM
ID EST
PLVMBI IN AVRVM
SPECTANTE OPTIMO
PRINCIPE
CAROLO PHILIPPO
COMITE PALATINO RHENI
SACRI ARCHIDAPIFERO ELECTORE
DVCE IVLIACI CLIVIAE
ET MONTIVM DVCE
PROCVRANTE SERENISSIMO
PRINCIPE
CAROLO LVDOVICO
EIVSDEM FILIO
ATQVE IN HAC MONETA
AD PERENNEM REMEMORIAM
POSTERITATI DONATA

kindly allowed him to have plaster casts made, and from these handsome metallic facsimiles were made by courtesy of the Asst. Keeper of Coins and Medals of the British Museum. Two sets were made, one of which was presented to the British Museum. These are shown in the accompanying cuts. It is believed that numbers 2 and 3 have never been described by numismatists.

They form extraordinary and tangible proofs of the sincerity of the widely prevailing belief in transmutation that existed for centuries. Full descriptions of these medals and more than forty others will be found in a paper entitled "Contributions of Alchemy to Numismatics," read before the American Numismatic and Archæological Society, Dec. 5th, 1889, and published in their journal.

METHOD OF DETERMINING INDIGOTINE FOR COMMERCIAL PURPOSES.

By F. A. Owen.

Under the above heading the author published a paper in this journal in Nov., 1888; the process as there described has been materially modified, and as now practised in the mills of the Burlington Woolen Company, at Winooski, Vt., is as follows:

From the sample shave off and coarsely powder two or three grammes, from which weigh with exactness two portions of one gramme each. In the first determine the moisture by drying in a watchglass at 100° C. and afterwards ignite this portion and determine the ash. The second portion is brushed from the scale-pan directly into a glass mortar, ground for a time dry, then water is added and the grinding is continued for some time; the pestle is rinsed into mortar and the whole allowed to settle for a minute or so, and all that will freely pour off is decanted into a glass stoppered, 200 c. c. flask. The sediment is reground with water, and

decanted as before until the whole has been transferred. Three grammes of zinc dust and 60 c. c. of commercial strong ammonia are now added ; then the flask is filled to $\frac{1}{2}$ c. c. above the mark and shaken. Reduction takes place in from half an hour to two hours, during which time it should be shaken occasionally. When the reduction is complete the froth will subside and the solution become pale yellow, or, with some samples which contain chlorophyll or some non-reducible green coloring matter, greenish yellow. Then remove with a pipette 50 c. c. to a beaker or porcelain dish, add five or six drops of ether and agitate by blowing air through with the pipette, until most of the indigotine is precipitated. Acidify in moderate excess with HCl, heat to boiling, and pass through a tared filter ; dry at 100° C., and weigh. It is not necessary to take any special care to prevent absorption of moisture while weighing, only the filter paper must be, as nearly as possible, in the same condition as when tared. The results are accurate. The lots when bought and retested should show no variation from the sample except in the percentage of moisture, which will be higher than in the sample. Indigo often loses 20% in drying, and not infrequently yields 80% of indigotine, after drying.

THE CHEMICAL AND PHYSICAL CHANGES ATTENDANT UPON THE STERILIZATION OF MILK.

By Dr. Albert R. Leeds.

When milk is sterilized by heating in loosely plugged flasks immersed in a steam bath surface evaporation does not occur, and there is little or no pellicle formed on the surface, the sterilized milk presenting the same appearance, if the heat is not continued longer than one or two hours, as the original. Under the microscope the only visible changes effected in the boiled and sterilized milk is the coalescence of some of the fat globules into others of larger size, and the appearance of more shreds or coagula of separated caseinous matter.

The differences in the behavior of raw, boiled and sterilized milk when treated with dilute acid were not by any means as striking as anticipated. It is frequently stated that the precipitate formed with the two latter, requires less acid for its formation, is formed more quickly, and is in softer, finer, more flocculent masses than the clot or curd of raw milk. But on treatment with equal quantities of dilute acid added in successive portions, and waiting for equal intervals, I have not been able to satisfy myself that much difference between the three milks, exists. This is especially true when the separated casein, which is present in raw milk, has already been partly removed with the skin formed on heating, and which itself tends to increase the size and density of the clots of acidulated raw milk. It is indeed very difficult to form a judgment when the undiluted milks are used, since the clots remain suspended in the remaining cloudy liquid, and their size and appearance can readily be modified by manipulation and shaking. Better to see what takes place, each milk was diluted to twenty times its original volume with water, ten cubic centimetres of the

milk being taken, and then a cubic centimetre of acetic acid which itself had been diluted ten times was added. At first the flocks in the raw milk formed a precipitate more dense and occupying at the bottom of the vessel a notably less volume, than that precipitating out of the sterilized milk. In the former case the supernatant liquid was also more opaque from unprecipitated white particles, but after standing 12 hours, these differences in the bulk of the precipitate had disappeared, while the supernatant liquid from the sterilized liquid had a white turbidity and that from the raw milk was perfectly clear. The boiled milk failed to precipitate at all, and an additional cubic centimetre of acid had to be added to before its casein was thrown down.

It is necessary to have recourse to more accurate methods to discover the nature of the changes effected by heating. And the more important and striking is the following. When ordinary raw milk is diluted with 20 times its volume of water, and the precipitate is filtered off, the dilute acid filtrate gives on boiling an additional precipitate. Milk which has been heated for an hour (sterilized), or boiled for half an hour, behaves altogether differently. It gives a larger amount of precipitate with dilute acid, but yields no further precipitate on boiling the filtrate. The precipitate obtained with dilute acid must certainly be different in character, therefore, when raw milk is used and when cooked milk is tested, even though the differences are difficult to recognize by the eye alone.

If we call the albuminoid matter first precipitated C ; that separated on boiling A, and that remaining in solution even after boiling the acid liquid, P, the result obtained by experiment on a sample of milk, raw, boiled for half an hour, and sterilized for one hour were as follows :

	Raw.	Boiled.	Sterilized.
Total Albuminoids	3.303 per cent.	3.481 per cent.	3.383 per cent.
C ("Caseine")	2.814 " "	3.129 " "	2.928 " "
A ("Albumen")	0.144 " "	none " "	none " "
P (Soluble)	0.335 " "	0.352 " "	0.253 " "

Of course the total albuminoids must have been the same in amount in each case, but the formation of the skin on the cooked

milk by making it difficult to obtain a homogeneous sample, introduced slight discrepancies in the analyses.

I have put the name albumen in quotation marks, because while similar to the albumen of some authors, the precipitate obtained in this manner would not exactly correspond. Raising the temperature merely to the boiling point is not sufficient. Some albumen is still obtained on boiling the acid filtrate from the casein—the heating must be continued for some time.

Inasmuch as gastric digestion is performed in an acid medium, and precipitation would at once occur, the more complete precipitation of the albuminoid matter in cooked as compared with raw milk would exert a corresponding influence.

The ratio of C to A and P appears to be very variable.

In another sample of milk obtained from the same dairy C=2.713; A=0.464; P=0.332: Total=3.519. This gives a ratio of total albuminoids to casein of 100 : 77. The above sample of sterilized milk gives for the same ratio 100 : 89. It is important to note that a like change is produced in the condensation of milk for canning. Though the heating is carried on in vacuo, yet it is sufficient to raise the percentage of the albuminoids precipitable by dilute acid in the cold very notably. If the heating is continued long enough and is sufficiently raised to render the canned milk entirely sterile, the effect above noted is very evident. Thus in a sample of "sterilized condensed Swiss milk," the total albuminoids were 10.599% and the casein 9.81% giving the ratio of 100 : 93.

Plate cultures of this condensed milk showed it to be entirely sterile, no bacteria colonies appearing when the plates were kept many days. And it is not surprising that this condensed milk is rendered absolutely sterile, when another evidence of prolonged heating is considered, which is the brownish color. Laboratory experiments upon the sterilization of milk in a steam bath showed that no change of color took place at the end of one hour, an hour and a half or two hours. At the end of three hours the change was perceptible and in six hours the sterilized milk had become strongly brownish-yellow resembling an infusion of coffee to which a large amount of milk has been added. Polariscopic determina-

tions were made of the amount of milk-sugar present after each heating, the raw milk containing 4.18 per cent. No change could certainly be estimated until the end of the six hours period when the percentage had fallen to 3.94, and it then steadily diminished until at the end of 48 hours the milk-sugar had entirely disappeared. There was a corresponding change of taste and color, the former acquiring more and more of that peculiar sweet and bitter flavor percepitable in boiled milk, and which I am inclined to attribute to the change of the milk-sugar, and the color at the same time becoming of a dark brownish-yellow. The decomposition product of the milk-sugar is the chief substance concerned in the development of the brown color, but not entirely since the mixture of casein and albumen separated from such heated milk and treated with ether to remove all the fat, has on drying, a strong yellow color. The casein obtained in a similar manner from raw milk dried perfectly white, and the albumen is white also. The fact that the albumen by heating becomes precipitable by dilute acid is one evidence of its change of character, and that on drying this changed albumen beomes yellow is another evidence.

The decomposition of milk-sugar is attended with the development of an acid, probably glucic acid. Filtered off from the insoluble substances left after heating for 48 hours, the solution which no longer contained any milk-sugar, had a brown color and acidity thus developed from 100 cubic centimetres of milk was equivalent to 13.8 cubic centimetres of decinormal soda.

It may justly be objected that such great changes as the entire destruction of the milk-sugar are never met with in the condensed sterilized milk of commerce, or in commercially or privately sterilized milk. The objection while true, does not apply to the object which I had in view which was to carry the experiments far enough to find out what was the nature of the substances formed.

That the process of heating to prepare the sterilized condensed milks of commerce is not carried far enough to perceptibly lower their percentage of milk sugar may been seen from the following analyses of an American and a Swiss preparation. The American

had a slight tint, the foreign was distinctly brownish. The condensation in both cases had been carried to such a point that the crystals of milk-sugar had begun to separate, the admixture of water bringing out a distinctly granular appearance due, as the microscope also showed, to minute crystals of milk-sugar. I give the composition of the American variety when diluted with 2½ times its volume of water; when diluted to such a point that its total solids amounted to 13.4% (this being about the average total solids in our ordinary whole commercial milk); and the composition of the original condensed milk. The Swiss variety is similarly tabulated except that it was diluted for purposes of analysis with only twice its volume of water. The advertisements accompanying the samples stated that when diluted as above, each would have the strength of rich table milk. But such is not the case, and a commercial milk, if prepared from them by diluting to point recommended, would be condemned by an inspector as adulterated milk.

AMERICAN CONDENSED MILK.

	2½ times diluted.	Normal.	Original.
Milk-sugar	3.295	4.843	12.37
Fats	2.625	3.859	9.18
Total Albuminoids	2.647	3.890	8.26
(Caseine	1.906	2.802	)
Ash	0.546	0.802	1.91
Total Solids	9.113	13.394	31.72

SWISS "CONDENSED, STERILIZED CREAM MILK."

	2 times diluted.	Normal.	Original.
Milk-sugar	4.527	4.866	13.581
Total Albuminoids	3.506	3.798	10.599
(Caseine	3.27	3.515	9.81)
Fats	3.714	3.992	11.142
Ash	0.688	0.738	2.064
Total Solids	12.435	13.394	37.386

It is surprising that the composition of two milks, as may be seen from an inspection of the column marked "Normal," should be so strikingly similar when we consider that the cattle fed on the Swiss alps, and in the Western State, from which this American sample came, were of different breed, and that their feeding, care, etc., were also widely diverse. By carrying the condensation to a farther point and by more prolonged heating, the Swiss variety was made of a slightly brown color. But both were sterile and when, the cans having been opened, diluted milk was allowed to stand in flasks loosely stoppered with cotton wool, the contents of both cans and flasks soured and spoiled very slowly.

Condensed milk properly prepared is, in fact, sterilized milk in a concentrated, convenient and portable form. It is important to compare it with sterilized milk, prepared and sold in sterilized flasks, but without condensation. One of these preparations is stated to have been prepared from the milk of registered Jersey cattle, and to be especially adapted for use by infants, children, invalids and travelers.

The advertisements state that no alterations have been in the composition of the milk, and that the only manipulation which it has undergone is that of immediate transfer to glass bottles suitably stoppered, followed by sterilization with the heat of a water bath. The temperature of the bath is not stated, nor the length of time in which the bottles are immersed, but the heat is said to be adequate to destroy all the germs of fermentation, and that samples opened after six months have shown no change.

The advantages claimed for this sterilized milk are its preparation from the fresh milk before any opportunity of absorption of any considerable number of microbes; that in the brief interval between the milking and the sterilizing there is no time for the development of spores; that it easily made such a close copy of nature's nourishment that only really good breast milk is its equal; that it does not curd in solid masses, but like breast milk in small soft flakes.

In addition, the statement is made that the Jersey milk is richer in the elements needed for bone and tissue building than the milk of any other breed; that it yields an adequate and guar-

anteed proportion of cream, averaging 25 %, and that when diluted with an equal volume of boiled water the "cheesy element" is reduced to a proper proportion.

Samples of this commercial sterilized milk obtained in midsummer exhibited a separation of the fats in masses of considerable size. By moderate warming and shaking this fat could be partially diffused through the milk, but not in such a manner as to bring the sterilized milk back to the ordinary appearance of rich milk, or milk on which the cream has risen on standing and then has been shaken up again with the milk. Samples which were obtained later in the year, December, did not present this appearance, but resembled rich milk, and the separation of the fat in the former case was probably due to the samples having been kept in my laboratory for several weeks during very hot weather. The reaction was neutral. Cultures were made with gelatine peptone in the ordinary manner, but no growths were obtained, showing that sufficient heat and time had been given to render the milk entirely sterile.

The composition of one of the midsummer samples was as follows :

Total Solids determined directly	14.05%
Water	85.95

Constituents separately determined :

Fats	5.26
Albuminoids	3.92
Milk-sugar	4.26
Ash	0.726
Sum of constituents so determined	14.166

A midwinter sample (Dec. 12th) exhibited the following composition :

Total Solids determined directly	14.70%
Water	85.30

Constituents separately determined :

Fats	5.36
Albuminoids	3.92
Milk-sugar	4.62
Ash	0.79
	14.69

Both of these samples were sterile. The most striking eature is their high percentage of solids, and especially of fat, as might be anticipated from the statement as to the source of the milk. Milk containing a large percentage of fat is valuable for its butter-making qualities, but its advantages as a nutrient are open to question. Thus Uffelman (*Archiv. fur die gesammte Physiologie*, Vol. 29, p. 339), states, as the result of his experiments, that the milk-sugar is the constituent most completely used up in the process of digestion, the albumenoids following next, then the fat and finally the salts.

As to the apparatus used in sterilization I have employed the ordinary steam bath, which is a part of the usual Koch biological outfit, but the Arnold steamer made and sold for milk-sterilization expressly, is more convenient and satisfactory. The flasks were closed by the rubber stoppers recommended by Soxhlet, with a glass rod passing down through a hole in the center. But in the infant ward of the Philadelphia Hospital, the sterilized milk is heated in flasks loosely plugged with cotton-wool and placed in a bath of boiling water, and this arrangement is entirely satisfactory when the milk is to be used on the spot.

As to the number and character of the bacteria present in commercial milk, it is not necessary to my present purpose to speak at great length. Five samples purchased for me at the most untidy shops, in the poorest quarters of Jersey City, yielded after 36 hours culture 33600, 42000, 24720, 5832, and 154 colonies. The smallest numbers were obtained in the last two samples which were the richer milks having a yellowish-white color, while the other three were poor white milk.

Very interesting in this connection are the results obtained by the examination of the milk obtained from cows fed on brewers'

grains, and a mixture of grains and swill. An analysis of the brewers' grains showed that they were rich in albuminoids, and in so far contained a large amount of material available for nutrition. Two samples were analyzed :

	I.	II.
Water	74.81 per cent.	75.75 per cent.
Ash	1.25 " "	0.851 " "
Albuminoids	6.26 " "	5.807 " "

Or, calculated on the grains after drying :

Ash	4.97 per cent.	3.51 per cent.
Albuminoids	24.45 " "	23.95 " "

The first were fed to cattle affording the milk analysed under column I *a* ; the second, together with some swill, affording milk II *b*. Eleven cows were fed in the first case in a small stable, very dirty, without bedding. The udders were very dirty, but apparently without sores.

The cows had been driven into the stalls and secured by causing their heads to pass through a vertical slit, allowing of an up and down motion, and were to be kept their until their udders should dry up. Their food appeared to be passing through them with a constant fluid diarrhœal discharge. The milk had an alkaline reaction, and a peculiar taste.

In the second case the milk had an exceedingly disagreeable, repulsive taste, a slight butyric odor and a strongly alkaline reaction. In fact, the taste gave rise to the impression that soda had been surreptitiously introduced into the milk, without attracting the notice of the inspector who obtained these samples for me. The composition was as follows :

	I *a*.	II *b*.
Fats	3.92	2.89
Total Albuminoids	4.29	4.26
(Caseine	2.74	2.32)
(Albumen	1.55	1.94)
Milk-sugar	4.18	3.04
Ash	0.748	0.839
Total Solids	13.138	11.029

The ratio of the albuminous to the caseinous matters is abnormally high, as if due to the feeding with so large an amount of soluble nitrogenous matter. In the second sample the percentage of fats are abnormally low.

The first milk after 60 hours culture yielded 874 colonies per cubic centimetre; the latter 6500 colonies. After being heated for 15 minutes in the sterilizer, counting from the time when its inside temperature had reached 100° C., the latter milk had become sterile, yielding no colonies on culture.

As to the length of time to which milk should in general be kept at the temperature of boiling water in order to sterilize it, I am inclined to believe that the period of one hour usually recommended, is excessive. The experiments previously detailed show that as soon as the temperature of milk reached the boiling point, most of the "albumen" is so changed that it becomes precipitable in the cold by dilute acid, and even heating less than half-hour to 100° C., is sufficient to change the whole of it. The remaining albuminoids in milk are similar in their nature to peptones and are not precipitate by dilute acid or by boiling. But the bacteria are made up largely of albuminoids similar to the first two classes of bodies referred to and not to the last, and the probability of their escaping devitalization after half an hour's boiling is primarily not great. In fact experiments have shown that in the great majority of instances the sterilization is complete in a half hour or less time, and for this reason the prolongation of heating to an hour, with its attendant inconveniences, is in general an unnecessary precaution.

My thanks are due to Mr. Geo. W. McGuire, the State Dairy Commissioner of New Jersey, and to my assistant, Mr. Wm. G. Johnston, for their aid in the performance of the experiments detailed in this article.

ON THE NECESSITY FOR THE SYSTEMATIC INSPECTION OF WELLS IN CITIES AND TOWNS.

BY DURAND WOODMAN, PH. D.

In presenting the following analytical data obtained from an examination of wells in Newark, N. J., it may be remarked that the case under consideration is not a special one, but illustrates conditions which not only exist to-day in many cities and towns, but which are constantly reappearing whenever a new centre of population forms, and are always a fit subject for more stringent and systematic sanitary regulation than that to which they are usually subjected.

Newark presents the usual case of the growth of a city where the water supply from wells has long been superseded by an aqueduct service, except among the small minority who still persist in the use of wells, either through force of habit and old association, motives of economy, convenience, or sometimes among the poor, inability to have the city water close at hand, and occasionally through distrust of the aqueduct supply.

Many wells in a town become unfit for use before the introduction of a general system of water distribution, and sickness caused by them, or the impending danger of epidemics lead to the agitation which results in a change. But after the new supply is provided all interest in wells subsides; each well owner continues to use well water as long as he pleases, or until the family physician insists on its discontinuance. When a particular season develops an epidemic the Board of Health is aroused and many old wells are examined and closed; many more remain to cause future trouble.

An examination of over thirty wells in Newark, selected in as many different localities as possible, disclosed some very astonishing cases of badly contaminated water in daily use.

Referring to the tabular statement of analytical results, the first sample taken for comparison is water from the Passaic River, opposite the outlet of the Millbrook sewer, which, if not as bad as that much defiled river can furnish, is at least very much worse than any water ever drawn from a faucet in the city.

The first well water examined contained nearly twice as much free ammonia (.049 parts per 100,000) as this river sample, and had almost as bad an odor after standing a few hours. The second well, No. 224, a street pump only a block distant from the preceding, contains but .005 parts per 100,000 *total* ammonia, and would be rated a good water, while third, No. 227, is again an aggravated case. Free ammonia, .068 parts per 100,000.

Continuing, it will be found that fifteen out of thirty-two here tabulated are unfit for use, being contaminated in several instances to an extent which makes it seem almost impossible that they should be found tolerable.

Only one of the fifteen No. 297 contains less free ammonia than the sewer outlet sample. Of two of the fifteen it was stated by those living on the premises that the water was unfit to drink; but nothing had been done to prevent water being drawn from them by any one who chose to do so.

No. 245 containing .068 parts per 100,000 free ammonia and other conditions corresponding (see Table) was said to be "used only in hot weather."

FREE AND ALBUMINOID AMMONIA.

Referring to the table, it will be noticed that all the waters are characterized by a large proportion of free ammonia, which in No. 326 reaches the extreme figure 0.74 parts per 100,000, and in a well concerning which no warning was given by those on the premises.

The albuminoid ammonia is, in one case only, higher than in the sewer outlet sample or 0.05 parts per 100,000 in No. 284. This water was filled with minute green particles of a species of algae, imparting a greenish tinge to the entire mass.

CHLORINE.

It is well known that the value of the chlorine determination is relative only and taken alone, without a knowledge of the quantity

natural to waters of the locality in question, is likely to be very misleading.

A comparison of results in the chlorine column shows the want of uniform agreement between the evidence furnished by the amounts of chlorine and of ammonia.

The lowest chlorine is in No. 278, a water which at least would be called doubtful judged by the ammonia determinations, while in No. 358 a well on high ground with an abundant supply of water from the sandstone rock three times as much chlorine is found. (2.63.)

The same well also contains more chlorine than the river sample from opposite the sewer outlet.

No. 227, a very bad water, irrespective of chlorine, contains 5.07 parts per 100,000.

No. 271, in which free ammonia is only .003 and albuminoid ammonia only .007 parts per 100,000, contains 9.36 parts chlorine per 100,000 or nearly twice as much.

No. 290, an offensively bad water, is comparatively low in chlorine (3.22 parts per 100,000), while No. 281, a comparatively good water, contains nearly twice as much. (5.82 parts.)

No. 245, a very bad water, contains 4.38 parts per 100,000 chlorine, while No. 326 containing over ten times as much free ammonia, contains only 2.5 as much chlorine. (11.40)

Again, the first three wells, which are in the same neighborhood, yield almost precisely the same quantities of chlorine, while the ammonia varies from a very low figure in No. 224 to .049 in No. 217.

From these results it appears that a large proportion of chlorine is a normal characteristic of much of the water from wells in the level and lower part of the city, and also that it varies greatly. This level consists of gravel or "drift" and is about 30 feet above mean tide. An estimation of the chlorine contained in it gave the following result:

1,360 grams taken at a depth of seventeen feet and away from any source of contamination yielded 4.17 grams chlorine.

$$\frac{4.17 \times 100}{1360} = 0.306 \text{ per cent.}$$

or from ten to fifteen times as much as found ordinarily in earth at points distant from tidal ways. (The average of 21 determinations, U. S. Agricultural Report, 1885, p. 175, is 0.02 per cent.).

TEMPERATURE.

The temperature observations were made as a means of judging approximately, in cases when direct observation was impossible, as to whether the well was very shallow or affected to any great extent by surface drainage.

The temperature of deep seated springs corresponds very closely with the mean annual temperature of the locality, which, in the case of Newark, N. J., is 50.52° F.

In about two-thirds of the observations recorded the approximation to this figure is very close.

That of No. 358 observed at the end of the Summer (Sept. 10th) is 51.5° or one degree higher than the mean annual temperature.

The lowest recorded temperature 48° happens to be in a very shallow well, No 276, but this well is nothing more than the outflow of a vigorous spring which rises to within ten feet of the surface. (Observation made May 16th.)

DISTANCES FROM CONTAMINATING SOURCES.

Even among people otherwise well informed the notions as to safe distance between a well and a cesspool or privy vault seem to be vague to the extent of allowing them to take great risks.

In most of the cases here given in the column of distances between wells and vaults, probably no special thought or anxiety was ever expended. Each one has looked out for himself according to his own ideas, regardless of neighbors. Eight and ten feet are among the most striking figures giving evidence of the popular confidence in the filtering and purifying influences of limited thicknesses of earth, while the analytical results show to what extent such confidence is misplaced.

The question so frequently asked of the chemist, "How far distant from cesspool and privy vault must a well be placed to be safe?" is of course one that does not admit of a general answer;

natural to waters of the locality in question, is likely to be very misleading.

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The temperature of deep seated springs corresponds very closely with the mean annual temperature of the locality, which, in the case of Newark, N. J., is 50.52° F.

In about two-thirds of the observations recorded the approximation to this figure is very close.

That of No. 358 observed at the end of the Summer (Sept. 10th) is 51.5° or one degree higher than the mean annual temperature.

The lowest recorded temperature 48° happens to be in a very shallow well, No 276, but this well is nothing more than the outflow of a vigorous spring which rises to within ten feet of the surface. (Observation made May 16th.)

DISTANCES FROM CONTAMINATING SOURCES.

Even among people otherwise well informed the notions as to safe distance between a well and a cesspool or privy vault seem to be vague to the extent of allowing them to take great risks.

In most of the cases here given in the column of distances between wells and vaults, probably no special thought or anxiety was ever expended. Each one has looked out for himself according to his own ideas, regardless of neighbors. Eight and ten feet are among the most striking figures giving evidence of the popular confidence in the filtering and purifying influences of limited thicknesses of earth, while the analytical results show to what extent such confidence is misplaced.

The question so frequently asked of the chemist, "How far distant from cesspool and privy vault must a well be placed to be safe?" is of course one that does not admit of a general answer;

for the kind of soil, rock, etc., in which the well is sunk, the direction in which drainage tends, and other variable conditions necessarily make each case a subject for special inquiry.

NEED OF INSPECTION.

The conditions shown to exist by the foregoing seem in some instances almost incredible and prove without argument the necessity for systematic inspection to prevent the existence of wells in such a state as those described, many of which like the one previously referred to, are reserved for use in Summer weather.

Boards of Health of cities and towns should have complete lists of the wells in actual or possible use, an analysis of each sufficient to determine the character of the water, with particulars as to location and surroundings.

Annual inspection would result in closing such as were found to be approaching the limits of safety, while those showing no deterioration could remain in use.

In accordance with the results of such inspection well owners should be given a preliminary notice that the further use of the well is dangerous, naming a time limit, at the expiration of which, if not closed by the owner, it will be closed by authority of the Board of Health, at the same time posting a notice on the well house or pump stating that the water is unsafe to drink.

This allows opportunity for new arrangements to be made, if any are necessary, and prevents the ill feeling and opposition which summary proceedings always engender.

From one point of view, viz: the average conditions of proximity to sources of contamination, it would seem that the closing of all the wells herein described would be the only safe plan, and without proper inspection it most certainly would; but in some cases wells receive an abundant supply of deep spring water coming from considerable and safe distances through strata of the underlying rock, and such wells overflow, so to speak, through the adjacent soil instead of acting as centers of local drainage.

All these questions, however, would be decided from the records of inspection and proper action taken accordingly. When it is considered to what extent an epidemic may be spread through

the medium of bad wells before the means are discovered, nothing need be said to emphasize the risk and danger of allowing the existence of even one well such as nearly fifty per cent. of those described have been shown to be.

No.	Date.	Temperature F.	Approximate Depth.	Distance from Privy Vaults.	Color or Appearance	Odor.
215	**Apr. 28**	....	.....	.....	**Brown**	**Soapy.**
217	" 29	49°	33 ft.	40 ft.	Slight Opalescence	Soapy.
224	" 29	....	.....	.....	Clear.	.....
227	May 2	49°	.....	25 ft. 27 "	"	Offensive on standing.
229	" 2	55°	40 ft.	25 "	"	.....
232	" 3	49°	30 "	15 "	"	.....
237	" 4	55°	50 "	35 " 75 "	"	.....
245	" 11	50°	40 "	25 "	"	.....
247	" 18	50°	?	25 "	Opalescent.	.....
260	" 12	50°	30 "	17 "	Clear.	.....
268	" 14	51°	40 "	32 "	"	.....
271	" 16	51°	.....	25 " 25 " 30 "	Good.	.....
273	" 16	54°	.....	20 " 25 "	"	.....
276	" 16	48°	18 ft.	30 "	Yellowish. (Iron.)	.....
278	" 16	58°	28 "	18 "	Clear.	.....
281	June 18	54°	30 "	25 "	"	.....
284	" 20	54°	.....	8 "	Greenish Yellow.	Offensive on standing.
287	" 20	53°	.....	30 " 35 "	Clear.	.....
290	" 21	56°	.....	25 "	Clear.	Offensive on standing.
293	" 21	53°	33 ft.	25 " 30 "	Turbid.	....
297	" 21	53°	35 "	(6) 40–80 "	Excellent.	Earthy.
318	" 22	52°	.....	.....	"	.....
320	" 22	53°	.....	45 ft.	"	.....
323	" 27	54°	.....	....	"	.....
326	" 27	57°	... .	10 ft. 25 " 30 "	"	.....
330	" 28	52°	25 ft.	40 "	Yellowish Opalescence	Offensive on standing.
333	" 28	52.5	30 "	....	Clear.	.....
336	" 28	56°	.....	25 ft.	"	.....
340	" 29	55°	35 ft.	20 "	"	.....
357	July 29	54.5	.....	30 "	"	Offensive.
358	Sept. 10	51.5	55 ft.	30 " Water-tight 30 ft.	"	.....
423	.....	....	70 " piped.	Sewer.	"	.....

Parts per 100,000.

Ammonia, Free.	Ammonia, Albuminoid.	Chlorine.	Hardness.	Remarks.
0.026	**0.045**	**1.90**	**2.44**	**Passaic River,** opposite outlet to Millbrook Sewer. Tide going out.
.049	.008	5.20	17.90	Chain and Buckets.
Total	0.005	5.50	.....	Wooden pump. Edge of sidewalk.
0.030	.008	5.07	26.81	Pump.
.005	.004	10.53	21.40	
.001	.009	9.69	19.20	
.032	.010	12.24	16.00	
.068	.004	4.38	10.67	"Only used in hot weather."
.192	.010	10.54	18.07	
.038	.008	11.20	37.32	
.004	.003	5.85	13.06	"Used in Summer."
.003	.007	9.36	5.69	Wooden pump.
.011	.007	.....	.....	Pump 150 ft. from Morris Canal.
.005	.008	5.12	16.73	
.008	.007	0.88	5.54	
.002	.009	5.82	15.16	Wooden pump.
.027	.050	19.75	49.50	" "
.074	.017	17.05	13.44	" "
.055	.024	3.22	12.00	Pump. Said to be unfit to drink.
.062	.007	5.34	10.67	Brick lined well.
.017	.017	18.36	26.53	
.001	.005	3.88	11.90	Pump.
.005	.004	6.95	8.62	Wooden pump.
.148	.009	7.31	16.66	
.739	.016	11.40	19.35	Pump.
.325	.008	8.70	9.73	
.002	.013	.....	.....	Wooden pump.
.002	.005	3.73	15.13	Pump.
.002	.019	6.44	11.90	
.7306	.002	12.00	8.33	Pump.
.0002	.012	2.63	.....	
.0036	.012	15.00	23.00	Iron pump.

EXPERIMENTS ON MILK ANALYSIS.

By E. Waller, Ph. D.

Legislation regarding food adulteration has been frequent since mediæval times. The most decided step of general importance in English speaking countries however was the act of the English Parliament in 1872, under which, I believe, for the first time, the office of Public Analyst was created. That act has been modified by more recent ones, but the important and essential features have been retained. With the establishment of the office of Public Analyst the formation of a society of Public Analysts for mutual benefit and information naturally followed in the Autumn of 1874 (*Chemical News*, **31**, 58).

The Society at its very inception came to an agreement as to the standards or percentages of the component parts of several of the commonest articles of food, among them milk. The limits were set in the following terms, (*loc. cit.*), "milk shall contain not less than 9.0 per cent., by weight, of solids not fat, and not less than 2.5 per cent. butter fat."

The method of analysis was not, so far as I am aware, officially described, but apparently by a general, informal understanding, the method described by Wanklyn in his book on Milk Analysis (London, 1871) was generally adopted with the exception that the portion taken for analysis (usually 5 grms.) was weighed instead of measured as he recommends. The method consisted in drying this quantity of milk in a weighed dish over the water-bath for 3 hours, weighing to determine the water by loss, and then extracting the milk solids three times with boiling ether, decanting through a filter, evaporating the ether and weighing the fat. Previous to the formation of the Society of Public Analysts I had experimented on Wanklyn's method and had adopted a modification of it, known on this side of the water as the Wanklyn-Waller

method. The modifications consisted in finishing the drying in an air bath at 100° to constant weight, in increasing the number of applications of ether to six or more, and in checking the determination of butter fat by drying and weighing the exhausted milk solids. The filtration of the ethereal solution of fat was also dispensed with as unnecessary, (*Analyst* **9**, *69, and Cairn's Quant. Analysis, New Edition, p. 204*). About the beginning of 1884 the British Society of Public Analysts appointed a committee to investigate methods of milk analysis, and to report a method which should be recommended by the society. While this committee was still occupied with its labors, Mr. M. W. Adams brought up his method, which (*Chemical News*, **10**, *46*) consisted in absorbing the 5 grms., of milk taken for analysis into a paper coil, drying off and determining the water by loss, and then extracting the fat from the coil by means of an extractor of the Soxhlet pattern. This method gives a higher figure for the fat, and after trial was recommended by the committee as the method for fat.

But one additional point in the procedure has been adopted since that time, viz., the previous extraction of the coil with alcohol containing 10 per cent. of glacial acetic acid, followed by an ether extraction, to prepare it for use. The "limits" previously set by the society were also modified in consequence, that for solids not fat being put at 8.5 and for butter fat at 3 per cent., practically an assertion that by the Adams method 0.5 per cent. additional fat was obtained.

In the meantime, in the United States, the National Board of Trade offered in 1880 a prize for an essay on food adulteration, to be accompanied by the draft of an act to be recommended to our legislators. The prize was given to G. W. Wigner, a prominent member of the British Society of Public Analysts, and legislation followed.

Also, in 1884, the New York legislature passed an act creating a State Dairy Commissioner, and legal limits were fixed for the composition of milk which should be merchantable.

The act declared that whole milk should contain at least 12 per cent. of solids, of which 3 per cent. should be fat. Some other States have also passed similar laws. The New Jersey standard

was, I believe, the same as that in New York; that of Massachusetts called for 13 per cent. of solids.

In consequence, the question has often been put in court, not "Is it your opinion, as an expert, that the milk in question was skimmed?" but, "Did this milk contain less than 3 per cent. of butter fat?"—a distinction in which there was sometimes a great difference. When a case was brought into court in which between 2.5 and 3 per cent. of fat had been found by the Wanklyn-Waller method, the counsel for the defense has claimed that since, by the Adams method 0.5 per cent. of fat more was attainable, his client must therefore be regarded as innocent. A logical consequence of this reasoning, would, however be, that as the law had been framed in the light of results obtained by the W-W. method, that 3.5 per cent. of fat should be demanded, and that his client, on the face of the facts, could not be regarded as innocent.

The correctness of the results by the Adams method, is, however doubted by many chemists.*

Some investigations by the writer as to the comparative value of results by the two methods mentioned may therefore be of interest. The milks examined are designated as follows:

	Per cent. water.	Per cent. ash.
A. Certified as genuine	87.29	0.769
B. " "	88.03	0.723
C. " "	86.49	0.763
D. " "	86.94	0.797
E. Suspected sample	87.23	0.698
F. " "	88.86	0.695
G. " "	87.47	0.745
H. Purchased for experiment	87.596	
I. Sample H diluted with two volumes of water	95.963	
J. Cream from H	77.866	
K. Skim from H	88.668	

E. and F. were analyzed by other chemists in New York, in the regular course of business, and not as checks on this work. The

* Wanklyn, *Chem. News*, **53**, *70*.
Review of "*Wanklyn's Milk Analysis*," new edition. *Chem. News*. **53**, *213*, Johnstone. *Chem. News* **60**, *233 and 257*.

gentlemen, however, kindly permit me to quote their results (marked X.)

As a part of the investigation, the influence of the size and shape of the dishes used in the W-W. method was tested; the respective merits of the round (hemispherical) bottomed dishes, (recommended by Wanklyn) and of flat bottomed dishes was noted. The classes of dishes used were:

Designation.	Capacity.	Bottom.	Approximate diam. of
O		Flat	$2\frac{3}{8}$ inches
L		"	$2\frac{1}{2}$ "
S	$\frac{1}{2}$ oz.	Rounded	$1\frac{1}{4}$ "
V	1 oz.	"	$1\frac{1}{2}$ "
R	2 oz.	"	2 "
M	6 oz.	"	$2\frac{1}{4}$ "

Some of these dishes, when containing milk solids, were subjected to continuous extraction (marked "Con" in the Table). Mr. E. W. Martin, of the New York City Health Department, has devised a form of extractor which can be used with a platinum dish which I have here for inspection. It consists simply of a flask with a chamber above of sufficient size to accommodate the dish, which is surmounted by a worm condenser, the whole of glass, put together with ground joints. In the side of the dish is a hole through which can be passed a glass tube, suitably bent to form a syphon, by which means the intermittent flow of the ether, common to all extractors of the Soxhlet pattern is secured.

This apparatus was used where in the Table dish "O" with continuous extraction is specified.

Mr. Martin also suggested the use of tinned lead capsules (such as are used for making bottle caps) in which to evaporate the milk solids. When it may be desired to subject them to continuous extraction, they may be pinched together and inserted in the tube of an ordinary extractor. Such dishes are designated in the Table as "L."

No.	Method.	Dish.	FAT. One Extraction. Direct.	One Extraction. By Loss.	Two Extractions. Direct.	Two Extractions. By Loss.	Three Extractions. Direct.	Three Extractions. By Loss.
A	W-W. *con.*	O	3.972	3.740	4.081	3.987	4.091	3.942
"	W-W.	S	3.628	3.531	3.721	3.727	3.746	3.748
"	"	R	3.854	3.741		3.798		
"	Adams.		4.249		4.267			
"	"		4.339		4.563			
"	"		†4.124					
B	W-W.	S	2.957	2.900	3.073	2.963	3.089	3.098
"	"	V	2.977	2.905	3.049	2.969	3.081	3.054
"	"	M	3.237	3.100	3.265	3.041		
"	Adams.		3.277		3.283			
"	"		3.407					
C	W-W. *con.*	O	4.244	4.111	4.284	4.131		
"	W-W.		3.996	3.833	4.244	4.061	4.274	4.153
"	Adams.		4.449		4.467			
"	"		4.458		4.518			
D	W-W. *con.*	L	4.215	3.748				
"	W-W. *con.*†	L	4.000	4.319				
"	W-W,	V	3.728	3.748	3.907	3.907	3.967	3.957
"	W-W.	M	3.686	3.686	3.855	3.825	3.894	3.866
"	Adams.		4.184					
"	"		4.258					
E	W-W.	V	4.721	4.572	4.885			
"	W-W. *con.*	O	5.133	4.780				
"	Adams.		4.960		4.989			
"	"		5.015		5.025			
"	"		†5.151					
"	"		†4.994					
"	" X		5.030					
F	W-W.	R	2.800	2.700	2.897	2.827		
"	"		2.817	2.837	2.877	2.966		
"	W-W.*con.* X	O	3.070	3.080				
"	Adams. X		3.320					
G	W-W.	L	3.146	3.221	3.288	3.416		
	"	L	3.057	3.028	3.315	3.340		
	Adams.		3.823		3.823			
	"		3.812		3.822			
H	W-W.	L	3.439	3.334	3.497	3.641		
	Adams.		3.858					
I	W-W.	L	1.188	1.179	1.228	1.218		
	Adams.		1.450					
J	W-W.	L	14.561	14.592	14.636	14.679		
	Adams.		14.511					
K	W-W.	L	2.358	2.352	2.424	2.468		
	Adams.		2.731					

*Extracted through bone black.

†Treated as prescribed by Wanklyn. Water driven off by drying for three hours on the water bath only.

Samples H to K inclusive, were used for another test upon the relative action of the two methods, as will be detailed later.

In the table by an "extraction" is meant the ordinary degree of extraction usually given in the respective methods, viz., five or six applications of ether in the W-W. method, except when marked "*con.*" In these cases and with the Adams method twelve or more syphonings of the ether occurred. It will be seen that the W-W. method, as a rule, gives results 0.2 to 0.3 per cent. less than the Adams method, and not 0.5 per cent.

CHARACTER OF THE FAT.

The difference in odor between the fat obtained by the two methods was noted by many when the method was first published and tried. No other differences have, however, been pointed out. Tests were made on several of the lots of fat extracted. Though incomplete, the indication seems to be that some material not fat is extracted with the last portions of the fat. Whether it is extracted in sufficient quantity to affect the weight to the extent of difference noted between the two processes, cannot be confidently asserted.

One way of testing was as follows: To the fat from 5 grms. of milk was added about 25 c.c. of hot water and a drop or two of ammonia. After warming for about 15 minutes this was filtered, and the filtrate evaporated until the alkalinity was quite faint. It was then filtered, cooled, and tested with a drop of nitric acid, and one or two of strong mercuric nitrate solution, or with potassium ferrocyanide acidified with acetic acid. The fat obtained by the Adams method usually showed precipitates in this case, which suggested the presence of albuminoids, while that from the W.-W. method showed little or no precipitate of the kind, as the degree of extraction was less. Modifications of this treatment such as more or less dilution, more or less ammonia, or more or less heating, gave phenomena other than those described, but with a uniform method of treatment, the fat from the two methods showed different reactions. Fat extracted by the Adams method through bone black (previously exhausted with ether) gave reactions the same in kind, but apparently differing in degree from that obtained in the ordinary way. The difference in proportion (percentage) was practically *nil*.

Attempts were made to determine nitrogen in some of the fats,

but it was apparent that some disturbing influence existed, for which the most rational explanation seemed to be that the paper of the coils had absorbed small amounts of ammonia salts.

Extractions by either method could not be carried to the point where no visible residue was left on evaporating the ether, although it soon reached a point where it was unweighable. That from the W-W. method was fatty in character and appearance, although there appeared usually to be something else with it. That from the Adams method was less uniform in appearance, a portion resembling fat to the eye, but it was sticky to the touch like a soft resin. It was perfectly soluble in ether, and insoluble in water. When a drop of ammonia was added to the water, a partial solution seemed to take place, and it detached itself in white scales, which turned brown with strong ammonia, becoming green on exposure to the air. The weak ammonia solution on boiling up with Fehling solution and standing overnight showed a slight red deposit.

I have made an extractor, put together with ground glass joints throughout, to test thoroughly the question as to whether anything was due to the corks used in the connections. I have as yet had no opportunity to try it.

Dilution and Skimming Tests.

Samples H *to* K *inclusive.*

To test these methods in another way, some milk was purchased and the specific gravity taken. This was found to be 1.0325. A portion was diluted with exactly two measures of distilled water, and another (weighed) portion was skimmed, and then whole milk, dilution, cream and skim subjected to analysis by both processes. The results have already been given, but for convenience they may be restated.

Dilution.

Milk.	Method.	Per cent. Water.	Per cent. Fat.	
			Direct.	By Loss.
Whole milk H----	W-W	87.596	3.497	3.641
" " ----	Adams	"	3.858	
Dilution I--------	W-W	95.963	1.228	1.218
" --------	Adams	"	1.450	
Calculated by-----	W-W	95.777	1.190	
" -----	Adams	"	1.313	

It seemed more than probable that the apparent percentage of fat by loss on H was partially due to water unexpelled in the first drying (3.631—3.497=0.144%). A correction and recalculation on this assumption will of course show no change as to fat, but gives figures for water and solids not fat, more in accord. This would give :

	Water.	Solids not Fat.	
		By WW.	By Adams.
Whole milk H	87.740	8.763	8.402
Dilution I	95.963	2.809	2.587
Calculation for I	95.826	2.910	2.861

The fat in both cases is a little higher than the calculation calls for. In the case of the W.-W. method by 0.038, in the case of the Adams method by 0.137, a result more favorable to the consistency of the first named.

Skimming.

A small stoppered globe with a stopcock below, was weighed first empty and then, after partially filling it with the (well mixed) milk. After allowing it to stand quietly for about three hours, it was again weighed, and then the skim was run off from below, and the globe and cream weighed. The cream was run off into a separate beaker, and after pouring a few times through the globe to insure mixing, the products were analyzed as before. The data obtained were :

Weight of original milk	105.0065
After standing three hours	105.0020
Weight of cream	9.4330
Weight of skim	95.5690

Analysis :

	Water.		Fat (W-W)		Fat (Adams).
	Actual Result.	Corrected.	Direct.	Loss.	
Cream	77.866	77.909	14.636	14.679	14.516
Skim	88.668	88.712	2.424	2.468	2.731

Calculation :

		By W-W.		By Adams.	
	Grms. Sold's.	Grms. Fat.	Grms. S. n. f	Grms. Fat.	Grms. S. n. f
In 9.433 grms. Cream	2.0879	1.3086	0.7073	1.3688	0.7191
In 95.569 grms. Skim	10.8299	2.3166	8.5133	2.6100	8.2199
Sum	12.9178	3.6972	9.2206	3.9788	8.9890
In 105.002 gr's. Whole milk	13.0224	3.6719	9.3525	4.0510	8.9734
CORRECTED FOR WATER, AS BEFORE.					
In 9.443 grms. Cream	2.0838	1.3086	0.7032	1.3688	0.7150
In 95.596 grms. Skim	10.7878	2.3166	8.4712	2.6100	8.1778
Sum	12.8716	3.6972	9.1744	3.9788	8.8928
In 105.002 gr's. Whole	12.8732	3.6719	9.2013	4.0510	8.8222

Result by W-W. 0.0253 grms. high.
Result by Adams, 0.0722 grms. low.

With the cream the Adams method gives lower results than the W-W. method. This was evidently due to the selective action of the paper of the coil, it having been found exceedingly difficult to cause it to absorb the cream. The aqueous portion was more readily absorbed.

The W-W. method, though a little higher than calculation as before, gives closer results than the Adams, although by making an allowance for the imperfect absorption of the cream by the coil in the latter case, it would appear that each process is fairly consistent with itself, a result which was not anticipated. It suggests the query whether milk does not contain some constituent slightly or not at all affected when the milk solids are dried in a dish, which is however rendered soluble when the milk is dried on a coil of paper. Wanklyn has suggested a probable change in the albuminoids of the milk induced by drying on the coil.

The conclusions from these experiments may be thus summarized :

1. The determination of butter fat in milk by the Adams, method, does not usually give results 0.5 per cent. higher than by the W-W. method.

2. In the W-W. method more satisfactory results are obtained by extracting a few times with ether, drying and then extracting again, than by extracting without drying between.

3. In either case the extraction of the last portions of the fat appears to remove something not fat. More of this material appears to be remove in the case of the Adams than of the W-W. process. This material may exist ready formed in the milk, or may be formed by the physical treatment to which the sample is subjected.

4. In the W-W. method, flat bottomed dishes 2 to 2½ inches in diameter give the most satisfactory results.

5. With fairly rich cream, dilution or some similar device is advisable when the Adams' method is used.

6. The determinations of water in milk, are liable to be too low rather than too high.

Finally, attention should be called to the fact that the assertion that milk contains water, butter fat, casein, lactose and salts is only a broad general statement, which leaves out of account the true complexity of substances which undoubtedly exist in that fluid.

SOME CHEMICAL PRODUCTS OF BACTERIAL GROWTH, AND THEIR PHYSIOLOGICAL EFFECT.

By E. A. v. Schweinitz,

Chemical Laboratory, Bureau of Animal Industry, Washington, D. C.

For a short time I have been engaged in studying the chemical products formed by the hog cholera and swine plague germs by their growth in artificial culture media, and have succeeded in isolating an albumose and ptomaine from each.

To distinguish the products the names *Sucholotoxin* and *Sucholoalbumin* have been given to the substances from the hog cholera cultures, and *Suplagatoxin* and *Suplagoalbumin*, respectively, from the swine plague cultures.

The albumoses are white, pulverulent substances, soluble with difficulty in water, and precipitated from this solution by absolute alcohol. They can be obtained in crystalline plates by drying over sulphuric acid, *in vacuo*.

The ptomaines are best obtained in the form of the double platinum salts, as the hydrochlorides are difficultly crystallizable. These double salts are very light yellow in color, readily soluble in water, difficulty so in alcohol, and appear under the microscope as needle-like crystals. (Specimens of the albumoses and platinum salts were exhibited.)

A subcutaneous injection of a small quantity of these substances is sufficient to produce death in guinea pigs in from 24 to 48 hours.

If, however, a much smaller quantity is injected, and the injection repeated a number of times, the animals are protected from the corresponding disease when communicated by direct inoculation with the germ. In quite a long series of experments, the check animals invariably died, while the treated ones recovered after inoculation with the germ.

More recently, Dr. W. H. Gray, of Washington, and myself have conducted some experiments upon guinea pigs, and succeeded in producing great resistance and subsequently immunity from diphtheria, by first treating the animals with the chemical products obtained from cultures of the germ.

There is every reason to hope that these results can be turned to practical application in the diseases of both animals and men.

December 31, 1890.

THE JANUARY MEETING.

REGULAR MEETING, Jan. 2, 1891.

The meeting was called to order at 8:30 P. M., the President, Prof. G. F. Barker, of the University of Pennsylvania, in the chair.

The minutes of the December meeting were read and accepted.

The minutes of the second general meeting were read, amended, and accepted as amended.

Prof. Breneman, of the Committee of Conference for the Philadelphia meeting, then read the minutes of the conference held for the purpose of discussing ways and means to bring about a more general organization of American chemists.

Mr. Rupp moved that the report of Committee on Conference as read, be referred to the board of directors, and that the committee be discharged with thanks. Carried.

The election of new members being next in order, the following gentlemen were unanimously elected:

Prof. J. W. Baird, Prof. of Chemistry Mass. College of Pharmacy, Boston, Mass.

Mr. Robt. W. Schedler, N. Y. Tartar Co., Brooklyn, N. Y.

L. Meyers Connor, City Chemist, Dallas, Texas.

Wm. D. Phillips, 77 Pine street, New York.

Jerome W. Frank, Standard Varnish Co., 734 E. 14th street, New York.

For associate membership:

J. H. Saville, Thomasville, Ga.

The following names were proposed for membership :

George H. Clapp, 95 Fifth Avenue, Pittsburg, Pa.

Alfred E. Hunt, 95 Fifth Avenue, Pittsburg, Pa.

Mrs. Rachel Lloyd, Ph. D., Prof. Analyt. Chem. Univ. of Nebraska, Lincoln, Neb.

Hudson H. Nicholson, Prof. Chem. Univ. of Nebraska, Lincoln, Neb.

Albert H. Welles, N. Y. Tartar Co.

C. H. White, U. S. Navy Yard, Mare Island, San Francisco, Cal.

The resignations of Messrs. Narcisse Pigeon, Yonkers, N. Y., and C. H. Nichols, New York City, were read and accepted.

A communication from Dr. H. Carrington Bolton, in reference to establishing an *Index Chemicus*, was read and referred to the Board of Directors.

Prof. Breneman read an application from Prof. J. H. Appleton, of Providence, R. I., accompanying an application signed by ten members of the Society residing within the State of Rhode Island, who desired to form a Local Section to have its headquarters in Providence, R. I., and to conduct the business of the State of Rhode Island.

Referred to the Board of Directors.

Mr. Rupp moved that a committee be appointed to consider what action should be taken in recognition of the 50th anniversary of the founding of the London Chemical Society. Carried.

The Chair appointed Messrs. Rupp, Breneman, and McMurtrie as such a committee. There being no further business the meeting was adjourned at 10:45 P. M.

DURAND WOODMAN,
Recording Secretary.

REPORT OF THE TREASURER OF THE AMERICAN CHEMICAL SOCIETY.

December 31st, 1896.

Resources.		*Liabilities.*	
Cash in Trust Co	$95 25	Personal accounts	$301 54
Personal accounts	410 46	Dues	355 00
Initiation Fees	10 00	Initiation Fees	20 00
Dues	30 00	Subscriptions, Journal	11 10
Amer. Chem. Soc.	141 93		
	$687 64		$687 64

Gains.		*Losses.*	
Special Subscription (Newport)	$45 00	Expense Newport meeting, Total	$127 35
Special Subscription ('89)	50 00	Expenses Phila. (partial)	40 00
Subscriptions to Journal	64 90	" Election	33 95
Advertisements	136 80	" General	323 01
Extra work, Diagram	15 00	" Revision Const'n	51 86
Initiation Fees	70 00	" Premium on Ins. Policy	8 75
Dues for 1885	5 00	" Journal	1,267 00
" 1886	5 00	Reprints	63 20
" 1887	10 00		
" 1888	55 00		
" 1889	110 00		
" 1890	890 00		
" 1891	5 00		
Interest on Trust Co. Bal.	5 48		
Am. Chem. Soc.	448 03		
	$1,915 21		$1,915 21

E. & O. E.

FRANK T. KING, *Treasurer.*

Abstracts of American Patents Relating to Chemistry.

(From the U. S. Patent Office Gazette.)

Issued January 6, 1891.

444,004.—Salicylate of phenyldimethylpyrazolone. H. Lüttke and L. Scholvien.

Obtained by heating, preferably under pressure, phenylhydrazine, acetyl acetic ether, and methyl salicylic ether in the presence of a halorid hydric acid.

444,044.—Welding compound. W. W. Brown and M. C. Reynolds.

Consists of borax, ammonium chloride, potassium ferrocyanide and soapstone.

444,068.—Apparatus for making extracts from tan bark. J. Hutchings and W. N. Hutchings.

444,084.—Process of enameling photographs and other prints. C. C. F. Brandt.

Consists of celloidine, alcohol and ether.

444,091.—Apparatus for the manufacture of gas. L. Stevens.

444,107.—Manufacture of sugar. G. Adant.

444,135.—Detergent. J. Scharr.

Consists of water, sodium carbonate, potassium carbonate, soap bark, crude turpentine, gum arabic, ammonium chloride, crude petroleum, olein, olive oil, phenol, salicylic acid and camphor.

444,152.—Apparatus for treating whiskey. F. Madlener.

444,187.—Cleaning composition. D. E. Sumner.

Consists of beef gall, cactus root, soap, sal soda, borax, oil of sassafras and water.

444,202.—Process of distilling oil. A. Mason.

444,203.—Apparatus for distilling oil. A. Mason.

444,229.—Compound for coloring broom corn. R. M. Donovan.

Consists of green aniline, burnt alum, water and sulphuric acid.

444,300.—Rotary gas scrubber. W. Mooney.

444,315.—Apparatus for the manufacture of lamp black. R. Dreyer.

(Issued January 13, 1891.)

444,483.—Filter, etc. F. Breyer.

444,538.—Blue dye. J. Mohler and C. A. Mayer.

Coloring matters obtained by sulpho-conjugating the new products resulting from the action of the primary aromatic amines on the dyes obtained by the action of the nitroso derivatives of the tertiary aromatic amines on the condensation products of tannin with aniline and its homologues, said coloring matters being scarcely soluble in water, soluble in concentrated sulphuric acid with a cherry red color, and forming with the alkalies with a copper red lustre readily soluble in water and alcohol with a greenish blue color, soluble in concentrated sulphuric acid with a cherry red color.

444,626.—Lubricating compound. W. Brinck.

Prepared by the action of mineral oils on finely divided caoutchouc at ordinary temperature.

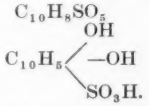
444,665.—Anti-fouling paint. N. B. Denny's.

Consists of zinc sulphate, mercuric sulphate, ferric oxide, cupric oxide, zinc slag, zinc, solution of tannin, and shellac varnish.

444,679.—Dioxynaphthaline-mono-sulphonic acid. M. Ulrich.

A new dioxynaphthaline-mono-sulphonic acid or its salts produced by melting the salts of alpha-naphthol, alpha-disulphonic acid S, with caustic alkali in a closed or an open vessel.

It has the following properties: the soda salt crystallizes in small white leaves which are easily soluble in water or alcohol of 60% ; by adding ferric chloride to an aqueous solution a dirty green precipitate, and with some drops of calcium hypochlorite a changeable green solution is formed, the latter being decolorized by an excess; the new acid or its salts give with diazobenzene a new azo-dye stuff, similar in shade to acid magenta, and with ortho-tetrazo-ditolyl or tetrazodiphenyl ethers direct-dyeing coloring matters of bright blue shades. The chemical formula of the acid is:



444,704.—Apparatus for distilling wood. A. Koch.

444,772.—Apparatus for purifying water. W. Anderson.

444,775.—Process of manufacturing artificial ivory. A. de Pont and S. de Pont.

An aqueous solution of phosphoric acid is added to lime, and the resulting phosphate is mixed with finely divided earthy mineral matters, and gelatin and albumin. The mass is then dried and subjected to great pressure while hot.

444,776.—Compound for calcimine. G. A. Casselman.

Consists of whiting, marble dust, gypsum rock, borax, zinc sulphate, alum and glue.

Issued January 20th, 1891.

444,833.—Apparatus for refining oil. B. N. Hawes.

444,842.—Paint. N. J. Mitchell.

Consists of coal tar, yellow ochre, plumbago, lime, salt and coal oil.

444,997.—Process of treating zinc ores. W. West.

Consists in roasting the ore to form sulphurous acid gas and oxidize the zinc, then cooling this gas to a temperature of 180° F. or below, and passing the same in gaseous form in conjunction with steam and without oxidation into sulphuric acid and through a previously roasted charge to form soluble sulphite of zinc, and then immediately leaching out the zinc sulphite with water at a temperature below 180° F.

445,053.—Filter press.—R. Giebermann.

445,054.—Apparatus for separating gluten from slaughter house washings. R. Giebermann.

445,055.—Process of separating gluten from slaughter house washings. R. Giebermann.

The washings are heated, treated with an aluminium compound and filtered.

445,091.—Process of dissolving water glass. P. Sievert.

The lump water glass is placed in a pile in a vessel and a current of steam discharged against it to soften it, while at the same time a spray of alkaline lye is applied. W. R.